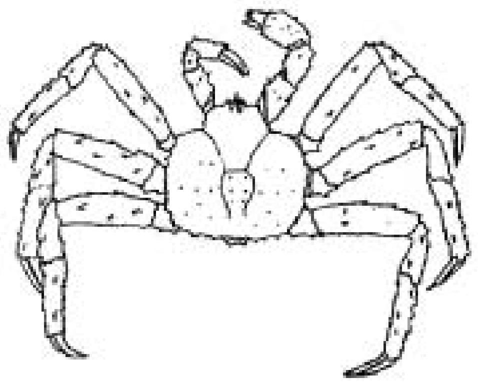
DRAFT FOR SECRETARIAL REVIEW
ENVIRONMENTAL ASSESSMENT
for proposed
AMENDMENT 17
to the Fishery Management Plan for the
King and Tanner Crab Fisheries in the Bering Sea/Aleutian Islands

A Rebuilding Plan for the Pribilof Islands Blue King Crab Stock



Abstract: Amendment 17 is a rebuilding plan for the Pribilof Islands blue king crab stock. The Magnuson-Stevens Fishery Conservation and Management Act requires a rebuilding plan when a stock has been declared overfished. The National Marine Fisheries Service declared the Pribilof Islands blue king crab stock overfished on September 23, 2002. This Environmental Assessment analyzes alternative approaches to harvest strategies, including status quo management, as rebuilding plans for the Pribilof Islands blue king crab stock. Three alternative rebuilding strategies are examined: Alternative 1, the status quo management of this fishery; Alternative 2, a rebuilding plan which allows for some directed harvest prior to the stock being rebuilt; and Alternative 3, a rebuilding plan which allows for no directed harvest prior to the stock being rebuilt. Options under each alternative include a range of thresholds for opening the fishery, a range of harvest strategies for the directed fishery, and conservative time periods above the designated threshold for opening the fishery. No additional habitat or bycatch measures are proposed in any of the alternatives because neither habitat nor bycatch measures were expected to have a measurable impact in rebuilding. The impacts of alternative rebuilding plans upon habitat, marine mammals, seabirds, fishing communities and other potentially impacted entities are discussed in the analysis. The minimum time period for rebuilding under all of the alternatives with a 50% probability is 9 years, and the maximum time period is 10 years.

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Executive Summary

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The spawning biomass of the Pribilof Island blue king crab stock has been declining since reaching its most recent peak in 1995. In 2001 the spawning biomass (7.0 million pounds) was just above its MSST (6.6 million pounds). Abundance continued to decline into 2002, resulting in a spawning biomass value (4.5 million pounds) that falls below the MSST established for this stock (6.6 million pounds). On September 23, 2002, NMFS declared the stock overfished and informed the Council. According to regulations under the Magnuson Stevens Act a rebuilding plan must be developed within one year.

This environmental analysis addresses alternatives for rebuilding the Pribilof Islands blue king crab stock. Alternative approaches to harvest strategies, including status quo management, for Pribilof blue king crab were analyzed as rebuilding plans. Three alternative rebuilding strategies are examined: Alternative 1, the status quo management of this fishery; Alternative 2, a rebuilding plan which allows for some directed harvest prior to the stock being rebuilt; and Alternative 3, a rebuilding plan which prohibits directed harvest prior to the stock being rebuilt. Options under each alternative include a range of thresholds for opening the fishery, a range of harvest strategies for the directed fishery, and conservative time periods above the designated threshold for opening the fishery. No additional habitat or bycatch measures are proposed in any of the alternatives because neither habitat nor bycatch measures were expected to have a measurable impact in rebuilding. Habitat is thoroughly protected from fishing impacts by the existing Pribilof Islands Habitat Conservation Zone. Bycatch of blue king crab in both crab and groundfish fisheries is an extremely small proportion of the total population abundance. At least two options for each alternative were proposed and examined.

The three alternatives are:

Alternative 1: Status Quo Management of the fishery.
Two options, 1A and 1B:

- Alternative 1A:

1) Threshold: 0.77-million males ≥120-mm CL
2) Opens: in 1st year stock is above threshold
3) Harvest rate on mature males: 20% of survey estimate
4) Cap on harvest of legal males: 60% of survey estimate
5) Minimum GHL: 0.5 million pounds

- Alternative 1B:

1) Threshold: 1.00-million males ≥120-mm CL
2) Opens: in 2nd consecutive year stock is above threshold
3) Harvest rate on mature males: 10% of survey estimate
4) Cap on harvest of legal males: 20% of survey estimate
5) Minimum GHL: 0.5 million pounds

Alternative 1A is the harvest strategy for Pribilof blue king crab developed by ADF&G in 1990 and described by Pengilly and Schmidt (1995). Actual management of the Pribilof blue king crab stock since development of the harvest strategy for Pribilof blue king crab has been more conservative than Alternative 1 (see Section 2.2.2), however. Accordingly, Alternative 1B was also examined as an alternative that more closely reflects the more conservative "status quo management in practice."

Alternative 2: A Rebuilding Plan with Some Directed Harvest Prior to the Stock Being Rebuilt
Four options, 2A to 2D are:

- Alternative 2A

1) Threshold: MSST (6.6-million pounds spawning biomass)
2) Opens: in 1st year stock is above MSST
3) Harvest rate on mature males: 10% of survey estimate at MSST, increases linearly with survey estimate of spawning biomass (or proxy thereof) to 20% at B_{MSY}
4) Cap on harvest of legal males: 40% of survey estimate
5) Minimum GHL: 0.5 million pounds

- Alternative 2B

1) Threshold: MSST (6.6-million pounds spawning biomass)
2) Opens: in 2nd consecutive year stock is above MSST
3) Harvest rate on mature males: 5% of survey estimate at MSST, increases linearly with survey estimate of spawning biomass (or proxy thereof) to 10% at B_{MSY}
4) Cap on harvest of legal males: 20% of survey estimate
5) Minimum GHL: 0.5 million pounds

- Alternative 2C

1) Threshold: 7.5-million pounds of males ≥120-mm CL and females ≥100-mm CL
2) Opens: in 2nd consecutive year stock is above threshold
3) Harvest rate on mature males: 10% of model estimate at threshold, increases linearly with the estimates of total mature biomass to 20% at 25-million pounds of males ≥120-mm CL and females ≥100-mm CL
4) Cap on harvest of legal males: 30%
5) Minimum GHL: 0.5 million pounds

- Alternative 2D

1) Threshold: 7.5 million pounds of males ≥120-mm CL and females ≥100-mm CL
2) Opens: in 2nd year stock is above threshold
3) Harvest rate on mature males: 10% of model estimate at threshold, increases linearly with the estimates of total mature biomass to 15% at 25-million pounds of males ≥120-mm CL and females ≥100-mm CL
4) Cap on harvest of legal males: 30%
5) Minimum GHL: 0.5 million pounds

Alternatives 2A and 2B allow for directed harvest when the stock is above the MSST overfished level, 6.6-million pounds of spawning biomass (total mature male and female biomass). Alternative 2B is more conservative than Alternative 2A, however, with stricter criteria for a fishery opening, and lower harvest rates when the fishery opens. Alternatives 2C and 2D have a higher stock threshold than MSST: 7.5-million pounds of males ≥120-mm CL and females ≥100-mm CL. Alternative 2C and 2D differ from each other in the harvest rate applied to mature male abundance, with Alternative 2D having the lower harvest rate.

Alternative 3: A Rebuilding Plan with No Directed Harvest Prior to the Stock Being Rebuilt
Two options, 3A and 3B:

- Alternative 3A

1) Threshold: B_{MSY} (13.2-million pounds of spawning biomass)
2) Opens: in 1st year stock is above B_{MSY}
3) Harvest rate on mature males: 20% of survey estimate
4) Cap on harvest of legal males: 40% of survey estimate
5) Minimum GHL: 0.5 million pounds

- Alternative 3B **(preferred)**

1) Threshold: B_{MSY} (13.2-million pounds of spawning biomass)
2) Opens: in 2nd year stock is above B_{MSY}
3) Harvest rate on mature males: 10% of survey estimate
4) Cap on harvest of legal males: 20% of survey estimate
5) Minimum GHL: 0.5 million pounds

Alternative 3 allows for no fishery on the Pribilof blue king crab stock until the stock level returns to the B_{MSY} level, defined as 13.2-million pounds of spawning biomass in the FMP. Two options are examined. Option 3B is the more conservative of the two options, with a stricter criteria for a fishery reopening and a lower harvest rate when the fishery reopens.

The alternatives and options for alternatives differ from each other in: (1) the stock threshold criteria for opening the fishery; (2) the harvest rate applied to what are considered mature males for management purposes (i.e., males ≥120-mm carapace length, CL); and (3) the maximum allowed harvest rates on legal-sized males (6.5-inches carapace width, corresponding to approximately 135-mm CL). Threshold criteria differ among alternatives and options for alternatives in the stock level defined as threshold and in the number of consecutive years that the stock is above threshold. Some options require that the stock be above threshold for two consecutive years before a fishery opening; that criteria is intended to provide greater assurance that the stock is above threshold before reopening the fishery. In each alternative and option for each alternative a minimum GHL of 0.5 million pounds is used as a measure to promote manageability of the fishery.

The minimum time period for rebuilding is 9 years (T_{min}), with a 50% probability of rebuilding within this time period, and the maximum time period is 10 years (T_{max}). Alternatives 1A and 2A provided for the highest possible mean annual yield in a 10, 20 and 35 year time horizon. However, these alternatives also had a much higher proportion of potential years with the stock below MSST for the same time horizon. By comparison, Alternatives 1B, 2B, 2C, and 2D provide shorter timeframes for rebuilding and lower proportions of years with the stock below MSST. Alternative 3B also has a short rebuilding time and low proportion of years below MSST, but Alternative 3B shows some reduction in yield relative to Alternatives 1B, 2B, 2C, and 2D. Alternatives 1B, 2B, 2C, and 2D would produce short timeframes for rebuilding and low proportions of years below MSST coupled with relatively high mean yields. Each provides for some directed harvest prior to the stock being rebuilt, which may alleviate some of the financial burden on the affected communities.

Although the Council had previously selected alternative 2D (which allowed for some directed fishing prior to the stock being completely rebuilt) in June 2003 as their preliminary preferred alternative, the Council revised its previous selection given the concerns expressed regarding the rebuilding potential of this stock. Given the potential vulnerability to overfishing, the poor precision of survey estimates, and the limited bycatch information available, the Council decided that a more conservative rebuilding plan, alternative 3B, was warranted at this time for this stock. The Crab Plan Team had recommended alternative 3B and the

Board of Fisheries had also selected alternative 3B as their preferred harvest strategy given similar concerns for the Pribilof Blue King Crab stock.

The rebuilding plan does not contain implementing regulations so a regulatory impact review under E.O. 12866 and initial regulatory flexibility analysis under the Regulatory Flexibility Act are not required.

Purpose and Need for Action

1.0 Introduction

The king and Tanner crab fisheries in the Exclusive Economic Zone (EEZ) (3 to 200 miles offshore) of the Bering Sea and Aleutian Islands off Alaska are managed under the Fishery Management Plan for Bering Sea/Aleutian Islands (BSAI) King and Tanner Crab. This fishery management plan (FMP) was developed by the North Pacific Fishery Management Council (Council) under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). The BSAI King and Tanner crab FMP was approved by the Secretary of Commerce and became effective in 1989.

Actions taken to amend the FMPs or implement other regulations governing the BSAI crab and groundfish fisheries must meet the requirements of Federal laws and regulations. In addition to the Magnuson-Stevens Act, the most important of these are the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), Executive Order (E.O.) 12866, and the Regulatory Flexibility Act (RFA).

NMFS declared the Pribilof Islands blue king crab (*Paralithodes platypus*) stock overfished, according to the criteria in the BSAI King and Tanner Crab FMP, on September 23, 2002. The recent stock assessment showed that the stock was below minimum stock size threshold (MSST) and there were no signs of recovery in the trawl survey data. Pursuant to Magnuson-Stevens Act guidelines, once a stock has been declared overfished, a rebuilding plan must be developed within one year.

This Environmental Assessment (EA) addresses alternatives for rebuilding the Pribilof Island blue king crab stock as required under the Magnuson-Stevens Act. The sections of the Magnuson-Stevens Act that must be satisfied are: National Standard 1 section 301(a)(1); Required provisions 303(a)(10) and 303(a)(14); Rebuilding overfished fisheries 304(e); and national standard guidelines 50 CFR 600.310. To the fullest extent possible, the rebuilding alternatives adhere to the National Marine Fisheries Service (NMFS) Technical Guidance on Rebuilding (Restrepo et al 1998).

None of the alternatives are likely to significantly affect the quality of the human environment, and the preparation of an environmental impact statement for the proposed action is not required by Section 102(2)©) of the National Environmental Policy Act or its implementing regulations. The rebuilding plan does not contain implementing regulations so a regulatory impact review under E.O. 12866 and initial regulatory flexibility analysis under the Regulatory Flexibility Act are not required.

1.1 Purpose of and Need for the Action

This proposed action is a rebuilding plan for the Pribilof Islands blue king crab. The need for this action is the decline in abundance of the Pribilof Islands stock of blue king crab below the overfished level established for this stock. The purpose of this action is to rebuild this stock within the required time frame, and this action is necessary to comply with the Magnuson-Stevens Act, National Standard 1 guidelines, and the FMP.

The Magnuson-Stevens Act, in section 303(a)(10), requires that each FMP specify objective and measurable criteria (status determination criteria) for identifying when stocks or stock complexes covered by the FMP are overfished. To fulfill the intent of the Magnuson-Stevens Act, such status determination criteria are comprised of two components: A maximum fishing mortality threshold (MFMT) and a minimum stock size threshold (MSST) (see Sec. 600.310(d)(2)).

Amendment 7 to the BSAI King and Tanner Crab FMP redefined overfishing, Optimum Yield (OY), and Maximum Sustained Yield (MSY), and updated the FMP with new information. The amendment established MSY point estimates, along with MSST for individual crab stocks based on prevailing environmental conditions (1983-1997 period). Overfishing is now defined as a fishing mortality rate in excess of natural mortality (M=0.2 for king crabs, M=0.3 for Tanner crabs). Overfished is defined as a biomass that falls below MSST, regardless of the causes of the stock decline. The 2002 NMFS Eastern Bering Sea trawl survey indicated that the Pribilof Islands blue king crab stock was below the MSST established for this stock (Figure 1).

The spawning biomass of the Pribilof Island blue king crab stock has been declining since reaching its most recent peak in 1995. In 2001 the spawning biomass (7.0 million pounds) was just above its MSST (6.6 million pounds). While there are concerns regarding the imprecision of estimates, the stock has been approaching MSST for some time (Figure 1). Abundance continued to decline into 2002, resulting in a spawning biomass value (4.5 million pounds) that falls below the MSST established for this stock (6.6 million pounds). On September 23, 2002, NMFS informed the Council that the stock was declared overfished. According to regulations under the Magnuson Stevens Act a rebuilding plan must be developed within one year.

1.2 Scope of this Environmental Analysis

This environmental analysis addresses alternatives for rebuilding the Pribilof Islands blue king crab stock. The impacts of alternative rebuilding plans upon habitat, marine mammals, seabirds and other potentially impacted entities will be discussed. This analysis does not address measures in the FMP that are not directly related to the Pribilof Islands blue king crab stock and alternative rebuilding strategies. Other related NEPA documents exist which address different issues relevant to the BSAI Crab FMP.

1.2.1 Related NEPA Documents

The BSAI king and Tanner crab FMP has been amended 15 times since the FMP was adopted in 1989. An environmental assessment (EA) and an RIR/IRFA (as applicable) was prepared for each amendment. A environmental impact statement (EIS) is currently being prepared for the BSAI king and Tanner crab FMP. That EIS will deal with all aspects of management under the crab FMP as well as analysis of the alternative strategies proposed for rationalizing the BSAI crab fishery. This analysis will be submitted to the Council for initial review in February 2004.

1.2.2 Project Area

Blue king crab in the Bering Sea are present as unique populations located near the Pribilof Islands, St. Matthew Island, and St. Lawrence Island. This rebuilding plan is for the Pribilof Islands blue king crab stock only. The Saint Matthew Island blue king crab stock is under a separate rebuilding plan (amendment 14 to the BSAI crab FMP).

The Pribilof Islands blue king crab population centers in the area between and surrounding the Pribilof Islands. The Pribilof Islands blue king crab stock is managed by the Alaska Department of Fish & Game, under the deferred management framework in the FMP. The management unit is the Pribilof District of the Bering Sea Management Area. The Pribilof District is defined as Bering Sea waters south of the latitude of Cape Newenham (58° 39’ N lat.), west of 168° W long., east of the United States – Russian convention line of 1867 as amended in 1991, north of 54° 36’ N lat. between 168° and 171° W. long and north of 55° 30’

N lat.between 171° W. long and the U.S.-Russian boundary. This stock distribution overlays 4 NMFS statistical areas for the Bering Sea: 513, 514, 521, and 524 (Figure 2).

1.3 Applicable Laws and Other requirements

The applicable laws for this rebuilding plan include the National Environmental Policy Act, the Magnuson-Stevens Act, the Endangered Species Act, the Marine Mammal Protection Act, and the Data Quality Act. The rebuilding plan does not contain implementing regulations so a regulatory impact review under E.O. 12866 and initial regulatory flexibility analysis under the Regulatory Flexibility Act are not required.

1.3.1 National Environmental Policy Act

The National Environmental Policy Act (NEPA) is an environmental mandate that declares a national policy to encourage productive and enjoyable harmony between man and the environment, and to promote efforts to better understand and prevent damage to ecological systems and natural resources important to the nation. NEPA requires federal agencies to evaluate the potential environmental effects of any major planned federal action in order to ensure that public officials make well-informed decisions about the potential impacts. NEPA also promotes public awareness of potential impacts at the earliest planning stages of major federal actions. The Act requires federal agencies to prepare a detailed environmental evaluation for any major federal action significantly affecting the quality of the human environment. As with the Magnuson-Stevens Act, NEPA requires an assessment of both the biological and social/economic consequences of fisheries management alternatives, in order to provide the public an opportunity to be involved and influence decision making on federal actions.

Federal fishery management actions subject to NEPA requirements include the approval of FMPs, FMP amendments, and FMP implementing regulations. Such approval requires preparation of either (1) an environmental impact statement (EIS) for major fishery management actions that significantly affect the quality of the human environment, and documents that finding for public consideration and comment before a decision is made, or (2) an environmental assessment (EA) for fishery management actions that will not significantly affect the human environment. If an EA does not result in a finding of no significant impact, then an EIS must be prepared. In addition to NEPA implementing regulations (at 40 CFR 1500-1508), NEPA compliance by fisheries management actions is guided by NOAA Administrative Order 216-6.

None of the alternatives in this rebuilding plan are likely to significantly affect the quality of the human environment, and the preparation of an environmental impact statement for the proposed action is not required by Section 102(2)©) of the National Environmental Policy Act or its implementing regulations.

1.3.2 Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act)

The Magnuson-Stevens Act is the principal federal statute that provides for the management of U.S. marine fisheries. NEPA and the Magnuson-Stevens Act requirements for schedule, format, and public participation are compatible and allow one process to fulfill both obligations. The basic concepts of the Magnuson-Stevens Act include the following:

6) The biological conservation of a fishery resource has priority over its use.
7) Conservation and management decision making must be based on the best available scientific information, which should include social, economic, and ecological factors along with biological factors.

8) The needs of fishery resource users vary across the nation, and public participation in the policy making process should be maximized.

The Magnuson-Stevens Act also established ten National Standards that serve as the overarching objectives for fishery conservation and management (16 U.S.C. 1851, Sec. 301[a].). National Standard 1 is applicable to achieving optimum yield from fisheries while preventing overfishing.

(1) Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.

Rebuilding of overfished stocks is required by the Magnuson Stevens Act, Section 304. The applicable section of the Act is provided below.

(e) REBUILDING OVERFISHED FISHERIES.--

(1) The Secretary shall report annually to the Congress and the Councils on the status of fisheries within each Council's geographical area of authority and identify those fisheries that are overfished or are approaching a condition of being overfished. For those fisheries managed under a fishery management plan or international agreement, the status shall be determined using the criteria for overfishing specified in such plan or agreement. A fishery shall be classified as approaching a condition of being overfished if, based on trends in fishing effort, fishery resource size, and other appropriate factors, the Secretary estimates that the fishery will become overfished within two years.

(2) If the Secretary determines at any time that a fishery is overfished, the Secretary shall immediately notify the appropriate Council and request that action be taken to end overfishing in the fishery and to implement conservation and management measures to rebuild affected stocks of fish. The Secretary shall publish each notice under this paragraph in the Federal Register.

(3) Within one year of an identification under paragraph (1) or notification under paragraphs (2) or (7), the appropriate Council (or the Secretary, for fisheries under section 302(a)(3)) shall prepare a fishery management plan, plan amendment, or proposed regulations for the fishery to which the identification or notice applies--

(A) to end overfishing in the fishery and to rebuild affected stocks of fish; or

(B) to prevent overfishing from occurring in the fishery whenever such fishery is identified as approaching an overfished condition.

(4) For a fishery that is overfished, any fishery management plan, amendment, or proposed regulations prepared pursuant to paragraph (3) or paragraph (5) for such fishery shall--

(A) specify a time period for ending overfishing and rebuilding the fishery that shall--

(I) be as short as possible, taking into account the status and biology of any overfished stocks of fish, the needs of fishing communities, recommendations by international organizations in which the United States participates, and the interaction of the overfished stock of fish within the marine ecosystem; and

(ii) not exceed 10 years, except in cases where the biology of the stock of fish, other environmental conditions, or management measures under an international agreement in which the United States participates dictate otherwise;

(B) allocate both overfishing restrictions and recovery benefits fairly and equitably among sectors of the fishery; and

©) for fisheries managed under an international agreement, reflect traditional participation in the fishery, relative to other nations, by fishermen of the United States.

(5) If, within the one-year period beginning on the date of identification or notification that a fishery is overfished, the Council does not submit to the Secretary a fishery management plan, plan amendment, or proposed regulations required by paragraph (3)(A), the Secretary shall prepare a fishery management plan or plan amendment and

any accompanying regulations to stop overfishing and rebuild affected stocks of fish within 9 months under subsection ©).

(6) During the development of a fishery management plan, a plan amendment, or proposed regulations required by this subsection, the Council may request the Secretary to implement interim measures to reduce overfishing under section 305©) until such measures can be replaced by such plan, amendment, or regulations. Such measures, if otherwise in compliance with the provisions of this Act, may be implemented even though they are not sufficient by themselves to stop overfishing of a fishery.

(7) The Secretary shall review any fishery management plan, plan amendment, or regulations required by this subsection at routine intervals that may not exceed two years. If the Secretary finds as a result of the review that such plan, amendment, or regulations have not resulted in adequate progress toward ending overfishing and rebuilding affected fish stocks, the Secretary shall--

(A) in the case of a fishery to which section 302(a)(3) applies, immediately make revisions necessary to achieve adequate progress; or

(B) for all other fisheries, immediately notify the appropriate Council. Such notification shall recommend further conservation and management measures which the Council should consider under paragraph (3) to achieve adequate progress.

1.3.2.1 National Standard Guidelines

Further clarification on stock rebuilding under the MSA for National Standard 1 is provided in the excerpt below from the Final Rule on National Standard Guidelines published in the Federal Register on May 1, 1998.

Sec. 600.310 National Standard 1--Optimum Yield.

(e) Ending overfishing and rebuilding overfished stocks– (1) Definition. A threshold, either maximum fishing mortality or minimum stock size, is being ``approached'' whenever it is projected that the threshold will be breached within 2 years, based on trends in fishing effort, fishery resource size, and other appropriate factors.

(2) Notification. The Secretary will immediately notify a Council and request that remedial action be taken whenever the Secretary determines that:

(I) Overfishing is occurring;

(ii) A stock or stock complex is overfished;

(iii) The rate or level of fishing mortality for a stock or stock complex is approaching the maximum fishing mortality threshold;

(iv) A stock or stock complex is approaching its minimum stock size threshold; or

(v) Existing remedial action taken for the purpose of ending previously identified overfishing or rebuilding a previously identified overfished stock or stock complex has not resulted in adequate progress.

(3) Council action. Within 1 year of such time as the Secretary may identify that overfishing is occurring, that a stock or stock complex is overfished, or that a threshold is being approached, or such time as a Council may be notified of the same under paragraph (e)(2) of this section, the Council must take remedial action by preparing an FMP, FMP amendment, or proposed regulations. This remedial action must be designed to accomplish all of the following purposes that apply:

(I) If overfishing is occurring, the purpose of the action is to end overfishing.

(ii) If the stock or stock complex is overfished, the purpose of the action is to rebuild the stock or stock complex to the MSY level within an appropriate time frame.

(iii) If the rate or level of fishing mortality is approaching the maximum fishing mortality threshold (from below), the purpose of the action is to prevent this threshold from being reached.

(iv) If the stock or stock complex is approaching the minimum stock size threshold (from above), the purpose of the action is to prevent this threshold from being reached.

(4) Constraints on Council action.

(I) In cases where overfishing is occurring, Council action must be sufficient to end overfishing.
(ii) In cases where a stock or stock complex is overfished, Council action must specify a time period for rebuilding the stock or stock complex that satisfies the requirements of section 304(e)(4)(A) of the Magnuson-Stevens Act.

(A) A number of factors enter into the specification of the time period for rebuilding:
(1) The status and biology of the stock or stock complex;
(2) Interactions between the stock or stock complex and other components of the marine ecosystem (also referred to as ``other environmental conditions'');
(3) The needs of fishing communities;
(4) Recommendations by international organizations in which the United States participates; and
(5) Management measures under an international agreement in which the United States participates.

(B) These factors enter into the specification of the time period for rebuilding as follows:

(1) The lower limit of the specified time period for rebuilding is determined by the status and biology of the stock or stock complex and its interactions with other components of the marine ecosystem, and is defined as the amount of time that would be required for rebuilding if fishing mortality were eliminated entirely.

(2) If the lower limit is less than 10 years, then the specified time period for rebuilding may be adjusted upward to the extent warranted by the needs of fishing communities and recommendations by international organizations in which the United States participates, except that no such upward adjustment can result in the specified time period exceeding 10 years, unless management measures under an international agreement in which the United States participates dictate otherwise.

(3) If the lower limit is 10 years or greater, then the specified time period for rebuilding may be adjusted upward to the extent warranted by the needs of fishing communities and recommendations by international organizations in which the United States participates, except that no such upward adjustment can exceed the rebuilding period calculated in the absence of fishing mortality, plus one mean generation time or equivalent period based on the species' life-history characteristics. For example, suppose a stock could be rebuilt within 12 years in the absence of any fishing mortality, and has a mean generation time of 8 years. The rebuilding period, in this case, could be as long as 20 years.

(C) A rebuilding program undertaken after May 1, 1998 commences as soon as the first measures to rebuild the stock or stock complex are implemented.

(D) In the case of rebuilding plans that were already in place as of May 1, 1998, such rebuilding plans must be reviewed to determine whether they are in compliance with all requirements of the Magnuson- Stevens Act, as amended by the Sustainable Fisheries Act.

(5) Interim measures. The Secretary, on his/her own initiative or in response to a Council request, may implement interim measures to reduce overfishing under section 305(C) of the Magnuson-Stevens Act, until such measures can be replaced by an FMP, FMP amendment, or regulations taking remedial action.

(I) These measures may remain in effect for no more than 180 days, but may be extended for an additional 180 days if the public has had an opportunity to comment on the measures and, in the case of Council- recommended measures, the Council is actively preparing an FMP, FMP amendment, or proposed regulations to address overfishing on a permanent basis. Such measures, if otherwise in compliance with the provisions of the Magnuson-Stevens Act, may be implemented even though they are not sufficient by themselves to stop overfishing of a fishery.

(ii) If interim measures are made effective without prior notice and opportunity for comment, they should be reserved for exceptional situations, because they affect fishermen without providing the usual procedural safeguards. A Council recommendation for interim measures without notice-and-comment rulemaking will be considered favorably if the short-term benefits of the measures in reducing overfishing outweigh the value of advance notice, public comment, and deliberative consideration of the impacts on participants in the fishery.

1.3.2.2 Technical Guidance on Rebuilding

The National Standard 1 guidelines indicate that once biomass falls below the minimum stock size threshold (MSST), then remedial action is required "to rebuild the stock or stock complex to the MSY level within an appropriate time frame." Guidance for determining the adequacy and efficacy of rebuilding plans was prepared by Restrepo et al. (1998) "Technical Guidance on the Use of Precautionary Approaches to Implementing National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act". This guidance manual does not have the force of law, but instead provides technical details for stock assessment scientists.

1.3.2.3 Definitions from Crab FMP

The definition of optimum yield, MSY, and threshold levels were derived from definitions contained in the Magnuson-Stevens Act or on the guidelines. These definitions were adopted under Amendment 7.

Maximum sustainable yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions. MSY is estimated from the best information available. Proxy stocks are used for BSAI crab stocks where insufficient scientific data exists to estimate biological reference points and stock dynamics are inadequately understood. MSY for crab species is computed on the basis of the estimated biomass of the mature portion of the male and female population or total mature biomass (MB) of a stock. A fraction [20% for Pribilof Islands blue king crab] of the MB is considered sustained yield (SY) for a given year and the average of the SYs over a suitable period of time is considered the MSY.

Overfishing: The term "overfishing" and "overfished" mean a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce MSY on a continuing basis. Overfishing is defined for king and Tanner crab stocks in the BSAI management area as any rate of fishing mortality in excess of the maximum fishing mortality threshold, Fmsy, for a period of 1 year or more. Should the actual size of the stock in a given year fall below the minimum stock size threshold, the stock is considered overfished. If a stock or stock complex is considered overfished or if overfishing is occurring, the Secretary will notify the Council to take action to rebuild the stock or stock complex.

MSY control rule means a harvest strategy which, if implemented, would be expected to result in a long-term average catch approximating MSY. The MSY control rule for king and Tanner crabs is the mature biomass of a stock under prevailing environmental conditions, or proxy thereof, exploited at a fishing mortality rate equal to a conservative estimate of natural mortality.

MSY stock size is the average size of the stock, measured in terms of mature biomass of a stock under prevailing environmental conditions, or a proxy thereof. It is the stock size that would be achieved under the MSY control rule. It is also the minimum standard for a rebuilding target when remedial management action is required. For king and Tanner crab, the MSY stock size is the average mature biomass observed over the 15 years period, from 1983 to 1997.

Maximum fishing mortality threshold (MFMT) is defined by the MSY control rule, and is expressed as the fishing mortality rate. The MSY fishing mortality rate Fmsy = M, is a conservative natural mortality value set equal to 0.20 for all species of king crab, and 0.30 for all Chionoecetes species.

Minimum stock size threshold (MSST) is whichever is greater: one half the MSY stock size, or the minimum stock size at which rebuilding to the MSY level would be expected to occur within 10 years if the stock or stock complex were exploited at the maximum fishing mortality threshold. The minimum stock size threshold is expressed in terms of mature biomass of a stock under prevailing environmental conditions, or a proxy thereof. For king and Tanner crab, the MSST is one-half the MSY stock size.

1.3.3 Endangered Species Act

The Endangered Species Act (ESA) (16 U.S.C. 1531 et seq.) provides broad protection for fish and wildlife species that are listed as threatened or endangered. Provisions are made for the formal listing of species, development of recovery plans, and designation of critical habitats. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize species. Responsibilities for implementing the ESA are shared by the U.S. Fish and Wildlife Service (freshwater fish, birds, terrestrial mammals, and plants) and NMFS (anadromous and marine fish, marine mammals, sea grasses). Further information on the impacts of the crab fisheries on listed species is found under sections 3.2.4 and 4.3 of this document.

1.3.4 Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. 1361 et seq.), as amended through 1996, establishes a federal responsibility to conserve marine mammals. NMFS has management responsibility for cetaceans (whales) and pinnipeds (seals) other than walrus while the USFWS is responsible for all other marine mammals in Alaska including sea otter, walrus, and polar bear.

The MMPA's primary management objective is to maintain the health and stability of the marine ecosystem, with a goal of obtaining an optimum sustainable population of marine mammals within the carrying capacity of the habitat. The MMPA is intended to work in concert with the provisions of the ESA. The Secretary of Commerce is required to give full consideration to all factors regarding regulations applicable to the "take" of marine mammals, including the conservation, development, and utilization of fishery resources, and the economic and technological feasibility of implementing the regulations. If a fishery affects a marine mammal population, then the potential impacts of the fishery must be analyzed in the appropriate EA or EIS, and the Council or NMFS may be requested to consider regulations to mitigate adverse impacts.

Further information on the impacts of the crab fisheries on marine mammals is found under sections 3.2.4 and 4.3 of this document.

1.3.5 Data Quality Act

Section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Public Law 106-554) directed the OMB to issue government-wide guidelines that provide policy and procedural guidance for ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by federal agencies. This bill is known as the Data Quality Act. The OMB's guidelines require all federal agencies to develop their own guidelines for ensuring and maximizing the quality, objectivity, utility, and integrity of information disseminated by the agency. NOAA published its guidelines in February 2002 (available online at http://www.commerce.gov).

1.4 Next Steps in the Process

At its' October 2003 meeting, the Council took final action on the Pribilof Blue King Crab Rebuilding Plan. The Council selected alternative 3B as their preferred alternative under this rebuilding plan. This alternative does not allow for fishing prior to the stock being completely rebuilt to B_{MSY} (13.2 million pounds). The preferred alternative also contains additional conservative measures of opening in the second year that the stock is above this threshold, a harvest rate on mature males of 10% of the survey estimate, a cap on the harvest of mature males at 20% of the survey estimate and a minimum GHL of 0.5 million pounds (see section 2.3.3 for a description of this alternative). While the Council had previously selected alternative 2D (which allowed for some directed fishing prior to the stock being completely rebuilt) in June 2003 as their preliminary preferred alternative, the Council revised its' previous selection due to the concerns expressed regarding the rebuilding potential of this stock. Given the stock's potential vulnerability to overfishing, the poor precision of survey estimates, and the limited bycatch information available, the Council decided that a more conservative rebuilding plan was warranted at this time for this stock . The Crab Plan Team had recommended alternative 3B and the Board of Fisheries had also selected alternative 3B as their preferred harvest strategy given similar concerns for the Pribilof Blue King Crab stock. The Council noted that should the status of the stock change in the future they would consider amending the FMP again to allow for some harvest of the stock prior to the stock being completely rebuilt.

2.0 Alternatives Including the Proposed Action

This section gives guidance for alternative development, background and alternative formulation, and describes the range of alternatives proposed for analysis.

2.1 NEPA Guidance for Alternatives

The Council on Environmental Quality regulations for implementing the procedural provisions of NEPA require that the agency preparing the analysis must evaluate the environmental consequences of the proposed federal action and all reasonable alternatives to the proposed action. In this EA, the federal action is to implement a rebuilding plan for the Pribilof District blue king crab stock. Three alternative strategies for rebuilding plans are proposed in section 2.3. Alternatives that were considered but not selected for further analysis are reviewed in Section 2.4. The impacts of the alternatives are evaluated from information presented in Chapter 3 (Affected Environment) and Chapter 4 (Environmental Consequences). The information presented provides the basis for choice among alternatives by the decisionmakers and the public.

2.2 Background and Alternative Formulation

This section provides background information necessary to understand the development and formulation of alternatives examined in this analysis.

2.2.1 Status of Pribilof Islands blue king crab stock

North American blue king crab stocks are localized (Figure 3) and support relatively small fisheries. For example, combined landings from the Pribilof and St. Matthew Island areas have seldom exceeded 11-million pounds (5,000 t). The Pribilof Islands stock has been fished since 1966 when Japanese fishermen began exploratory efforts. The fishery produced an average of 2.9-million pounds (1,300 t) during the 1960s, which rose to 4.1 million pounds (1,850 t) in the 1970s. The Pribilof fishery reached a peak of 11.0-million pounds (4,980 t) in 1980, but soon declined precipitously to only 0.3-million pounds (120 t) in 1986. The fishery was closed in 1988 and only four fishing seasons have been allowed since. The fishery has averaged 0.8-million pounds (370 t) during the four fishing seasons allowed during the 1990s. Pribilof blue king crabs are among the largest of their species in the world and the season average size of landed crab often has exceeded 3.5 kg. By contrast, blue king crab average weight in the St. Matthew Island fishery seldom exceeds 2.2 kg. Other stocks of blue king crab occur in scattered locations in the Gulf of Alaska (GOA) and the eastern Bering Sea (EBS), but they are much smaller, rarely fished and have mostly been unsurveyed. Their scattered locations and frequent occurrence in fjord-like waters poses interesting zoogeographic and ecological questions (Somerton 1985).

Little stock specific assessment information is available for most Asian stocks, which tend to be located near continental coasts rather than islands. Russian stocks in the western Bering Sea (WBS), particularly along the Koryak coast, have yielded an average 4.0-million pounds (1,800 t) in recent years (1996-1999). In the Sea of Okhotsk, where several stocks occur, landings averaged 8.2-million pounds (3,720 t) between 1986-1999 and peaked at 16.7-million pounds (7,580 t) in 1997. The higher and steadier production of blue king crab in the WBS and Sea of Okhotsk may reflect more constant and colder conditions caused by the cold, southerly Siberian coastal current and proximity to the large relatively cold Siberian land mass to the west.

The domestic fishery began during the 1973/74 season when eight vessels harvested 1.3-million pounds (ADF&G 2002). Participation and landings increased through the 1980/81 season when 110 vessels harvested 11.0-million pounds. Annual harvests decreased to less than 1-million pounds during the 1984/85-1987/88 seasons and the fishery was closed from 1988 through 1994 due to low stock abundance. The fishery reopened in 1995 and remained open through the 1998 season, during which period harvests fell from 1.3 million pounds in 1995 to 0.5 million pounds in 1997 and 1998. The fishery was not opened for the 1999 season and has remained closed through the 2002 season. Catch per pot lift in the domestic fishery has decreased in a nearly monotonic fashion from 26 crab per pot during the 1973/1974 season to only two crab per pot by the 1987/1988 season. CPUE rose to 5 per pot when the season was reopened in 1995, but soon fell to 3 per pot in 1997 and 1998. Whereas some of the decline in CPUE could be attributable to the influx of vessels competing for crabs in the relatively small area inhabited by the Pribilof blue king crab stock, CPUE and survey estimates are well correlated from 1980 onward and both clearly are measures of a declining resource abundance.

Total mature biomass (TMB) of the Pribilof blue king crab stock is estimated annually by NMFS using data from the NMFS summer eastern Bering Sea trawl survey (Stevens, et al. 2002). Although poor precision in abundance estimates makes year-to-year comparisons difficult, the overall trend in estimated TMB since 1995 shows that this stock is depressed and in decline (Figure 1). The 2002 estimate for TMB was 4.5-million pounds. That value is below the minimum stock size threshold (MSST) of 6.6-million pounds that was established for this stock in 1998 (NPFMC 1999). Hence, NMFS declared the stock overfished. The 2002 estimate represents the first time since MSST was defined for this stock that the stock is estimated to be below MSST and it is the lowest estimate since 1989. Abundance of males and females by size class are estimated by NMFS using an area-swept method for the period 1982-2002 (Table 1; Stevens et al 2002). The NMFS area-swept estimate for total males in 2002 is the lowest on record and the estimate for total males and females in 2002 is the lowest since 1985. Abundance of legal and prerecruit-sized males by size class are estimated by ADF&G using a 4-stage catch-survey assessment model (Table 2; Vining and Zheng 2003). Those estimates indicate that the abundance of males of the size class considered mature for management purposes (≥120-mm CL) is at the lowest level since 1989. Size frequency distributions from 2002 for males (Figure 4) or for females (Figure 5) provide no suggestion of recruitment to the mature or legal component in the near future.

The 2003 survey estimate of TMB was 4.1 million pounds, a decrease from the 2002 SB estimate of 4.5 million pounds, and the 2001 survey estimate of 7.0 million pounds. This stock remains below the MSST of 6.6 million pounds. Although poor precision in abundance estimates makes year-to-year comparisons difficult, the trend in estimates since the mid-1990s indicates that this stock remains depressed and below MSST in 2003. Estimates of abundance for all male classes are low there is no indication that stock conditions are improving.

Under the existing harvest strategy developed for the Pribilof blue king crabs, fisheries are not opened unless the stocks exceed a threshold level of abundance (Pengilly and Schmidt 1995). The thresholds established for Pribilof Islands blue king crab is 0.77 million males > 119-mm carapace length (CL). Mature male abundance for 2003 is estimated at 0.291 million. The fishery has been closed since 1999 because the stock did not exceed the threshold level of abundance. Therefore, this population is declining in the absence of directed fishing pressure and in the absence of any bycatch during the Pribilof red king crab fishery; the Pribilof red king crab fishery has also remained closed since 1999. It is also worth noting that bycatch in trawl fisheries has not occurred due to the Pribilof trawl closure area. There is no evidence from this year's survey results that recruitment to the mature or legal male stock will occur in the near future.

It is noteworthy that the peak in mature abundance and biomass that occurred in the early-mid 1990s is an order of magnitude lower than the mature abundance and biomass that existed in the late 1970s and early

1980s. It is also noteworthy that the trend in decreasing TMB continued unabated during 1996-2002 despite institution of a trawl closure area to protect Pribilof blue king crab in 1995 and the closure of directed fishing on Pribilof blue and red king crab since 1999. Commenting on the stock's history relative to the current status, Otto (September 5, 2002 memorandum *in* NPFMC 2002) observed that:

> "Reasons for the decline in Pribilof blue king crab abundance are unclear. Blue king crab are cold-adapted relative to red king crab and have left what appear to be small isolated glacial remnant populations in specialized habitats in the Gulf of Alaska and warmer parts of the Bering Sea. Red king crab are the dominant species throughout the Gulf of Alaska and relatively warm portions of the Bering Sea. This may indicate a gradual replacement of blue king crab by red king crab during post-glacial time. Due to biennial spawning, larger eggs and smaller numbers of eggs per clutch, blue king crab may have considerably lower reproductive capacity than red king crab. As blue king crab have declined in the Pribilof Islands, red king crab have become more prevalent and this change in relative abundance has occurred during the warm water period of the past 20 or so years. Prior to this period red king crab were rarely taken in the Pribilof Islands area."

2.2.2 Management of the Pribilof Islands blue king crab fishery

Blue king crab stocks in the Bering Sea are managed by the State of Alaska under a federal BSAI king and Tanner crab fishery management plan (FMP). Under the FMP, management measures fall into three categories: (1) those that are fixed in the FMP under Council control, (2) those that are frameworked so that the State can change them following criteria outlined in the FMP, and (3) those measures under complete discretion of the State. In the Pribilof District king crab fisheries the state manages both a "general" fishery (a competitive fishery open only to vessels that qualify under the federal License Limitation Program) and a Community Development Quota (CDQ) fishery. The CDQ fishery is allocated 7.5 % of the annual harvest and is opened subsequent to the general fishery.

Amendment 5 to the BSAI crab FMP established a License Limitation Program (LLP) that requires participating catcher vessels to have a Federal Crab License, except that vessels less than 32 feet in length or vessels fishing exclusively in state waters are not required to have a Federal Crab License. Vessels licensed for the Pribilof king crab fishery have both a combined red and blue king crab endorsement. Most of the historic blue king crab harvest occurs in federal waters of the Pribilof District, (97.9%). As of May 2003, NMFS issued 136 licenses for the Pribilof District king crab fishery. Of the 136, 26 are interim licenses. In addition to the mandatory Federal Crab License the State requires preseason registration for all vessels. The preseason registration provides managers with effort information and is utilized to assign onboard observers.

King crab may only be taken with king crab pots. King crab pots have maximum dimensions, and have defined tunnel entrance openings. Furthermore, to permit escapement of small male and female crab, each pot must be equipped with a panel of 9-inch mesh. The large mesh must cover at least one-third of one vertical surface. To protect against ghost fishing each pot must be equipped with a biodegradable escape mechanism. The escape mechanism is designed to allow an 18-inch opening to develop in lost pots which permits the passage of crab and fish. The number of pots is capped for each vessel. Vessels larger than 125 feet in vessel length are permitted 50 pots and vessels 125 or less are allowed 40 pots. Pot limits are enforced through fishery-specific buoy tags.

The commercial fishery has a minimum size limit of 6.5 inches carapace width and only male crab may be taken. The size limit is based on economic as well as biological considerations. The male-only fishery retains all females for egg production and also allows for the marketing of larger male crab.

The regulatory fishing season is September 15 through April 15. Typically fishing has closed before the end of September when the annual guideline harvest level was achieved. The latest fishing season since 1980 extends into December. The fishery has occurred within the biologically acceptable season for king crab.

The State of Alaska annually determines the guideline harvest level based on results of the National Marine Fisheries Service trawl survey of the Eastern Bering Sea. The current harvest strategy was adopted in 1990 and provides a 20% harvest rate for mature males (defined as males greater than or equal to 120 mm CL). Harvest is capped at 60% of the legal male abundance. The current threshold for determining a harvestable surplus is 770,000 mature males. No harvest is allowed when the stock estimate is less than this threshold. Since adoption of the current harvest strategy, fishery openings and guideline harvest levels have been determined more conservatively than by strict application of that harvest strategy (see below).

ADF&G manages the blue king crab fishery based on real-time information provided from fishers. Information on total retained harvest and effort is received daily. ADF&G tracks the daily harvest and effort and projects the closure based on attainment of the guideline harvest level. Samples of the landed catch are obtained during offloads at shoreside and floating processors and onboard catcher-processors. In addition, an onboard observer program has been developed by the state under which observers can be assigned to vessels to collect information on bycatch and retained harvest. Onboard observers are scheduled for approximately 10% of the catcher fleet and 100% of the catcher-processor fleet during the general fishery and are deployed on vessels participating in the CDQ fishery. However, due to low participation by catcher-processor vessels in the Pribilof king crab fishery and closure of the fishery since development of the program for deploying observers on catcher vessels in 2000, observer coverage of Pribilof king crab fisheries has been very limited.

The current non-regulatory harvest strategy for Pribilof blue king crab was presented to and approved by the Alaska Board of Fisheries (BOF) at their spring 1990 meeting. That harvest strategy first became effective for the 1990 season, which had a regulatory opening date of September 1. The harvest strategy is described in Pengilly and Schmidt (1995) and has three components:

1. A threshold of 0.77 million males ≥120-mm carapace length (CL) – if the estimated abundance of males ≥120-mm CL is less than 0.77 million, the fishery remains closed for the season. Note that 120-mm CL is not the minimum legal size; it is the harvest strategy's operational definition for minimum size of functional maturity of males. Minimum legal size is 6.5-inches carapace width (CW), which corresponds to approximately 138-mm CL.
2. A 20% rate of exploitation on males ≥120-mm CL – if the fishery is opened, the target number of legal males for harvesting is equal to 20% of the estimated abundance of males ≥120-mm CL, unless constrained by component (3), below (under the current 6.5-in minimum legal size, legal males are generally ≥138-mm CL).
3. The harvest guideline is constrained to not exceed 60% of the estimated abundance of legal males.

Since 1990, ADF&G has actually managed the Pribilof District blue king crab fishery more conservatively than by strict application of the harvest strategy. That practice was seen as warranted due to:

1. The declines in stock levels during the mid-to-late 1980s that resulted in a fishery closure during 1988 and 1989; and,
2. The low precision for the population abundance estimates afforded by survey data for this stock.
3. Concerns related to manageability of the fishery with a potentially large fleet.

To address those concerns, management of the Pribilof blue king crab fishery has been closely tied to management of the Pribilof red king crab fishery and the St. Matthew blue king crab fishery. Since 1993 the opening dates of the St. Matthew blue king crab and Pribilof red and blue king crab fisheries have been coincident. The intent of coincident opening dates was to distribute the fleet between the St. Matthew and Pribilof fisheries, thereby decreasing effort in and increasing manageability of both fisheries. Additionally, since the Pribilof blue king crab fishery reopened in 1995, both the Pribilof red king crab and blue king fisheries have been opened and closed together with a pooled red-and-blue king crab guideline harvest level (GHL). Managers felt that opening the Pribilof king crab fishery under a pooled red-and-blue king crab GHL would buffer the effects of abundance estimation in setting the GHL. The pooled GHL was determined so that the harvest would not exceed 20% of the estimated abundance of males ≥120-mm CL from either stock. Additionally, if abundance of one stock was lower than estimated, fishers would be able to switch effort to the more abundant stock.

Decisions on opening the Pribilof blue king crab fishery and GHLs for opened fisheries during 1990-2002 are summarized in Table 3. The fishery remained closed during 1990-1994, the first five years following adoption of the present harvest strategy, although point estimates for "mature males" (i.e., males ≥120-mm CL) were above the threshold of 0.77 million. The fishery closures in those years were due to the high uncertainty on the abundance estimates of mature males, coupled with the concerns for reopening the stock to fishing after the declines observed in the late 1980's.

Although the lower confidence bounds for annual stock abundance estimates continued to fall below the threshold value, the fishery opened for the 1995 season and reopened for each season through 1998. The point estimate for abundance of mature males for each year during 1995-1998 was above the threshold value and several considerations lessened the conservation concerns on opening the fishery. Despite the poor precision of annual abundance estimates, the series beginning in 1990 of annual point estimates of abundance that were above the threshold value provided some confidence that the stock could be considered above threshold during 1995-1998. Changes in management practices beginning in 1995 that linked the management of red and blue king crab fisheries in the Pribilof provided additional confidence to managers that the fishery could be prosecuted while addressing conservation concerns.

In the 1995 fishery season, managers allowed blue king crab to be harvested as part of a combined blue and red king crab GHL that was determined by a 10% exploitation rate applied to the estimated abundance of red king crab males ≥120-mm CL (Table 4). Results of the 1995 fishery season, in which blue king crabs accounted for 1.3 million pounds of the total 2.1 million pound harvested, gave fishery managers greater confidence in the abundance estimates for the blue king stock. The 1996 through 1998 fishery seasons were each prosecuted under a combined GHL for red and blue king crab.

The fishery for blue king crab in the Pribilof District closed in 1999 when the abundance of males ≥ 120-mm CL was estimated at 0.8 million (Zheng and Kruse 1999). Although the 1999 point estimate was slightly above threshold, the 1999 season was closed due to concerns raised by a trend of declining abundance, estimated low abundance of prerecruits, low precision of abundance estimates, and past fishery performance below expectations. Additionally the closure of the St. Matthew blue king crab fishery in 1999 raised concerns that participation in a Pribilof king crab fishery could increase to an unmanageable level. The point estimate for mature-sized male blue king in the Pribilof District has been below the stock threshold for a fishery opening and the fishery has remained closed from 2000 through 2002. Because of uncertainties on red king crab stock abundance estimates and concerns on potential for bycatch of blue king crab as the blue king crab stock approached and fell below MSST, the fishery for red king crab in Pribilof District was also closed for the 1999-2002 seasons.

In summary, since 1990 status quo management of the Pribilofs blue king crab fishery has been driven by the need to address concerns due to poor precision in stock abundance estimation and concerns of fishery manageability during a period of low stock abundance. Because of high uncertainty in stock abundance estimation, the fishery was not opened until the point estimate for mature-sized (≥120-mm CL) males was above threshold for six consecutive years. The basis for the combined red and blue king crab GHLs varied over the four seasons that the fishery was opened (1995-1998; Table 3). However, the harvest as a percentage of annual stock abundance indices was relatively stable: 4%-5% of the estimated mature biomass, 8%-15% of the estimated abundance of legal males, and 6%-11% of the estimated abundance of mature-sized males (Table 4). In particular, the estimated harvest rate on mature-sized males was roughly one-half or less of the 20% specified in the harvest strategy adopted by ADF&G in 1990 (Pengilly and Schmidt 1995). Since 1990, with the intent of buffering effects on the stock due to errors in GHL specification and of reducing fishery effort to manageable levels, the fishery was opened only when both the Pribilof red king crab and the St. Matthew blue king crab fisheries were opened. Finally, during periods of stock decline to or below MSST, concerns on bycatch of Pribilof blue king crab have been addressed by closing the Pribilofs red king crab fishery.

2.2.3 Existing conservation measures

Existing management measures in Bering Sea crab fisheries that serve the conservation of the Pribilof blue king crab stock are reviewed here.

Definition of legal gear for BS/AI king and Tanner crab fisheries is fixed in the FMP as a Category 1 management measure. Trawls and tangle nets are specifically prohibited for fishing king and Tanner crab in the BS/AI due to the high mortality that they inflict on crab and other fish species. Outside of the prohibition on trawls and tangle nets, specifications on legal gear are management measures left to the discretion of the State of Alaska as a Category 3 management measure. BS/AI king crab can only be fished with king crab pots as defined in state regulations. By regulation each pot must be equipped with a panel of 9-inch mesh that covers at least one-third of one vertical surface to permit escapement of small male and female crab. Requirements for a biodegradable escape mechanism that allows an 18-inch opening to develop in any lost pot protects against ghost fishing. State regulations also require that the tunnel eye opening in pots used to fish snow and Tanner crab may not exceed 3 inches in height; the tunnel eye height restriction reduces bycatch of king crab during the snow and Tanner crab fisheries by excluding mature-sized king crabs from capture.

The State of Alaska determines fishery guideline harvest levels (GHLs) for the Pribilof blue king crab stock as a Category 2 management measure that is frameworked in the FMP. Guideline harvest levels must be set to avoid overfishing as defined in the FMP. The existing harvest strategy for Pribilof blue king crab (described in Section 2.2.2) establishes a threshold for a fishery opening and limits harvests to a percentage the mature-sized males (≥120-mm CL). Under the threshold criteria in the existing harvest strategy, the Pribilof blue king crab fishery was closed three years prior to the overfished declaration for the stock. Adjustments to GHLs can be made by the State as a Category 2 measure if in-season data indicates that continuation of the fishing season and attainment of the GHL poses a conservation risk. By State of Alaska statute, the Commissioner of ADF&G has the authority when circumstances require, to summarily open or close seasons or areas by means of an emergency order. Emergency order authority has been used since 1999 to close the Pribilof red king crabs fishery, in part as a conservation measure in response to a declining trend towards MSST in the Pribilof blue king crab stock abundance.

Size and sex restrictions for legal retention of harvested Pribilof blue king crab are established in State of Alaska regulations as Category 2 measures. Only males of greater than or equal to 6.5-inches CW may be legally harvested. Captured females and undersized males must be returned immediately and unharmed to the sea by State regulation. Sex and size restrictions are intended to allow males the opportunity to mate prior to being exposed to commercial harvest and to provide maximum female reproductive capacity to insure conservation of the resource (Schmidt and Pengilly 1990). Compliance with sex and size restrictions is monitored through a State dockside-sampling program and, on at-sea processors, through a State at-sea observer program.

Fishing seasons are established by State regulations as a Category 2 measure. Commercial fishing for Pribilof blue king crab can occur during the regulatory fishing season of September 15 through April 15, unless closed by emergency order, and have avoided the biologically sensitive molting/mating period for Pribilof blue king crab.

2.2.3.1 Pribilof Islands Trawl Closure

Amendment 21a to the BSAI groundfish FMP established the Pribilof Islands Habitat Conservation Area, effective Janaury 20, 1995. This amendment prohibits the use of trawl gear in a specified area around the Pribilof Islands year-round. The intent of this closure was to protect the unique habitat and ecosystem surrounding the Pribilof Islands so that it could contribute long term benefits to the fisheries surrounding the waters of the Pribilof Islands area (NPFMC, 1994). The Pribilof Islands area provides habitat for commercially important groundfish species, blue king crab, red king crab, Tanner crab, snow crab, juvenile groundfish, Korean hair crab, marine mammals, seabirds and their prey species.

Given the potential for the groundfish trawl fishery to disrupt the populations of fish, crab, seabirds and marine mammals and their prey species in this region, the Council decided to close the area shown in Figure 6. This area was established based upon the distribution and habitat of the blue king crab in the NMFS annual trawl surveys and based on observer data. Blue king crab do not exist uniformly across the Bering Sea and are instead found in isolated populations. The Pribilof Islands Habitat Conservation Area protects a majority of the crab habitat in the Pribilof Islands area (NPFMC, 1994).

The closure was implemented in January 1995. Bycatch of "other king crab" decreased dramatically from 1994 to 1995, particularly in the trawl gear sector. This decline in bycatch by statistical area gives an indication of the effectiveness of the trawl gear closure (Figure 7a). Areas 513 and 521 have the highest overlap with the PIHCA. This decrease was particularly noticeable in area 513, where the number of crabs caught by trawl gear decreased by approximately 89%, from 33,554 to 3,662 (Figure 7b). During the 1995-1998 Pribilof blue king crab fishery seasons, 3.3-million pounds were harvested from 13 ADF&G statistical areas; 64% of that catch was from statistical areas entirely inside the PIHCA, 26% was from statistical areas partially inside the PIHCA, and only 10% was from statistical areas outside of the PIHCA. A recent analysis of NMFS EBS trawl survey data from 1995 through 2002 indicates that, annually, 84% to 98% of the total surveyed Pribilof blue king crab population is inside the PIHCA (I. Vining, *personal communication*, ADF&G, Kodiak).

2.2.4 Development of Alternatives for this analysis

NEPA requires resource managers to identify and evaluate alternatives to the status quo before promulgating new actions. In this case, these alternatives represent different strategies for rebuilding plans. Under the MSA, each alternative must strive to rebuild the stock within ten years. An analytical working group comprised of ADF&G, NMFS and NPFMC analysts devised alternative rebuilding strategies. This range includes both directed harvest prior to the stock being rebuilt, no directed harvest prior to the stock being rebuilt as well as the status quo management of the stock. The general direction of these alternatives was consistent with previously approved rebuilding plans and the guidance of the Council's Scientific and Statistical Committee (SSC).

2.3 Description of Alternatives

In October 2003, the Alaska Board of Fisheries (Board) established the rebuilding harvest strategy for Pribilof District blue king crab as an integral part of a rebuilding plan for the Pribilof blue king crab stock. ADF&G has analyzed alternative harvest strategies for review by the Board. The rebuilding harvest strategy adopted by the Board is contained in the preferred alternative rebuilding plan analyzed in this EA.

Three alternative approaches to harvest strategies, including status quo management, for Pribilof blue king crab were analyzed as rebuilding plans. At least two options for each alternative were proposed and examined.

The three alternatives are:
- Alternative 1: The status quo harvest strategy, (the no action alternative)
- Alternative 2: A Rebuilding Plan with some directed harvest before the stock rebuilds to B_{MSY}
- Alternative 3: A Rebuilding Plan with no directed harvest before the stock rebuilds to B_{MSY}

The alternatives and options for alternatives differ from each other in the threshold and years above threshold before opening the fishery, the harvest rate applied to what are considered mature males for management purposes (i.e., males ≥120-mm CL), and the maximum allowed harvest rate on legal-sized males (i.e., males ≥6.5-inches carapace width, corresponding to approximately 135-mm CL). The thresholds in the alternatives are criteria for stock abundance that must be met before the fishery can be opened; if the stock is estimated to be below threshold, the fishery cannot opened. Depending on the alternative, the threshold is defined relative to the abundance of males ≥120-mm CL or relative to an index of mature male and female biomass. The thresholds in the harvest strategies for these alternative rebuilding plans are not to be confused with the MSST that defines the overfished level in the FMP; however, the threshold for some alternatives (2A and 2B) is set at MSST. In addition to the threshold, there are criteria for the number of years that a stock must be above threshold before the fishery is opened; depending on the alternative or option, the fishery may be opened in the first or second consecutive year that the stock is above threshold. The requirement in some alternatives or options that the stock be estimated to be above threshold for two second consecutive years is intended to provide some protection against the low precision of stock estimates provided by the survey data; i.e., to provide greater assurance that stock is, in fact, above threshold.

In addition to to the threshold and criteria for years above threshold, each alternative and option specifies a minimum GHL of 0.5 million pounds for a fishery opening. The minimum GHL is used as a measure to promote manageability of the fishery. The minimum GHL had not been specified in management prior to specification of these alternatives. ADF&G managers of the BS/AI king and Tanner crab fisheries have determined that a 0.5- million pound GHL is the minimum GHL that can be successfully managed in season without exceeding the GHL under the current management regime (i.e., existing pot limits and number of vessels qualifying to fish Pribilof District king crab under the License Limitation Program).

2.3.1. Alternative 1: The status quo harvest strategy

Two variants, Alternatives 1A and 1B, of status quo management as an alternative were examined. Alternative 1A is the harvest strategy for Pribilof blue king crab developed by ADF&G in 1990 and described by Pengilly and Schmidt (1995). Actual management of the Pribilof blue king crab stock since development of the harvest strategy for Pribilof blue king crab has been more conservative than Alternative 1A (see Section 2.2.2). Accordingly, Alternative 1B was also examined as an alternative that more closely reflects the more conservative "status quo management in practice."

Components of Alternatives 1A and 1B are:
- Alternative 1A:
  - Threshold: 0.77-million males ≥120-mm CL
  - Opens: in 1st year stock is above threshold
  - Harvest rate on mature males: 20% of survey estimate

- Cap on harvest of legal males: 60% of survey estimate
- Minimum GHL: 0.5 million pounds

- Alternative 1B (no action alternative):
- Threshold: 1.00-million males ≥120-mm CL
- Opens: in 2nd consecutive year stock is above threshold
- Harvest rate on mature males: 10% of survey estimate
- Cap on harvest of legal males: 20% of survey estimate
- Minimum GHL: 0.5 million pounds

The primary differences between these two variations on Alternative 1 are that 1B includes a higher stock threshold for opening, a provision to open in the second consecutive year that the stock is above the threshold and a more conservative harvest rate and harvest cap on legal males.

2.3.2. Alternative 2: A Rebuilding Plan with some directed harvest before the stock rebuilds to B_{MSY}

Harvest strategies analyzed under the Alternative 2 allow for some directed harvest prior to the time that the stock attains B_{MSY}. In each option harvest rates are lower at lower stock levels to increase the opportunity for rebuilding at low stock levels while allowing for directed harvest.

Alternatives 2A and 2B allow for directed harvest when the stock is above the MSST overfished level, defined in the FMP as 6.6-million pounds of spawning biomass (total mature male and female biomass); i.e, the threshold is set at MSST. Alternative 2B is more conservative than Alternative 2A, however, with the stricter criterion that the stock must be estimated above MSST for two consecutive years and with lower harvest rates applied when the fishery is opened. Alternatives 2C and 2D also have thresholds defined in terms of mature male and female biomass, but with a more conservative threshold definition than Alternatives 2A and 2B. The threshold for alternatives 2C and 2D is 7.5-million pounds of males ≥120-mm CL and females ≥100-mm CL as estimated from a catch-survey analysis model (Vining and Zheng 2003; see Section 4.1.1). Alternatives 2C and 2D differ from each other in the harvest rate applied to mature male abundance, with Alternative 2D having the lower harvest rate.

It is important to note that Alternatives 2A and 2B, on the one hand, and Alternatives 2C and 2D, on the other, differ from each other not only in the definition of threshold, but in the estimation method for indexing mature male and female biomass. For Alternatives 2A and 2B mature male and female biomass is indexed by the total mature male and female biomass estimate provided by NMFS; i.e., the estimate obtained by multiplying the area-swept estimate for each sex and 5-mm CL size group by the mean weight of the sex-size group and the estimated proportion mature in the sex-size group, dividing that product by the estimated survey catchability of the sex-size group, and summing over both sexes and each size group (NPFMC 1998). We will refer to that estimate as the "survey estimate." For Alternatives 2C and 2D total mature male and female biomass is indexed by the biomass of only males ≥120-mm CL and females ≥100-mm CL as estimated using the catch-survey analysis model. We will refer to that estimate as the "model estimate." For the same stock level, the index of mature biomass provided by model estimate will be lower than that provided by the survey estimate (see Section 4.1.2); in particular, the model estimate of 7.5-million pounds of males ≥120-mm CL and females ≥100-mm CL would correspond with approximately with a survey estimate of 9.1 million pounds of total mature male and female biomass.

Components of Alternatives 2A to 2D are:

- Alternative 2A
- Threshold: MSST (6.6-million pounds spawning biomass)
- Opens: in 1st year stock is above MSST
- Harvest rate on mature males: 10% of survey estimate at MSST, increases linearly with survey estimate of spawning biomass (or proxy thereof) to 20% at B_{MSY}
- Cap on harvest of legal males: 40% of survey estimate
- Minimum GHL: 0.5 million pounds

- Alternative 2B
- Threshold: MSST (6.6-million pounds spawning biomass)
- Opens: in 2nd consecutive year stock is above MSST
- Harvest rate on mature males: 5% of survey estimate at MSST, increases linearly with survey estimate of spawning biomass (or proxy thereof) to 10% at B_{MSY}
- Cap on harvest of legal males: 20% of survey estimate
- Minimum GHL: 0.5 million pounds

- Alternative 2C
- Threshold: 7.5-million pounds of males $\geq$120-mm CL and females $\geq$100-mm CL
- Opens: in 2nd consecutive year stock is above threshold
- Harvest rate on mature males: 10% of model estimate at threshold, increases linearly with the estimates of total mature biomass to 20% at 25-million pounds of males $\geq$120-mm CL and females $\geq$100-mm CL
- Cap on harvest of legal males: 30%
- Minimum GHL: 0.5 million pounds

- Alternative 2.D
- Threshold: 7.5 million pounds of males $\geq$120-mm CL and females $\geq$100-mm CL
- Opens: in 2nd year stock is above threshold
- Harvest rate on mature males: 10% of model estimate at threshold, increases linearly with the estimates of total mature biomass to 15% at 25-million pounds of males $\geq$120-mm CL and females $\geq$100-mm CL
- Cap on harvest of legal males: 30%
- Minimum GHL: 0.5 million pounds

2.3.3 Alternative 3: A Rebuilding Plan with no directed harvest before the stock rebuilds to B_{MSY}

Alternative 3 allows for no fishery on the Pribilof blue king crab stock until the stock level returns to the B_{MSY} level, defined as 13.2-million pounds of spawning biomass in the FMP. Two options are examined. Option 3B is the more conservative of the two options, with a stricter criteria for a fishery reopening and a lower harvest rate when the fishery reopens.

Components of Alternatives 3A to 3B are:

- Alternative 3A
- Threshold: B_{MSY} (13.2-million pounds of spawning biomass)
- Opens: in 1st year stock is above B_{MSY}

- Harvest rate on mature males: 20% of survey estimate
- Cap on harvest of legal males: 40% of survey estimate
- Minimum GHL: 0.5 million pounds

- Alternative 3B **(preferred)**
- Threshold: B_{MSY} (13.2-million pounds of spawning biomass)
- Opens: in 2^{nd} year stock is above B_{MSY}
- Harvest rate on mature males: 10% of survey estimate
- Cap on harvest of legal males: 20% of survey estimate
- Minimum GHL: 0.5 million pounds

2.4 Alternatives Considered and Eliminated from Detailed Study

Two additional broad alternatives for a rebuilding plan were initially considered but were eliminated from the analysis without further development or detailed study. Both included a harvest strategy for multiple stocks as a component of the plan. The first was a rebuilding plan that included a combined harvest strategy for Pribilof and St. Matthew Island blue king crab. That alternative was originally suggested because fishery openings for the St. Matthew blue king crab and Pribilof king crab fishery have been closely tied together to distribute fleet effort and improve manageability of both fisheries. Additionally, a rebuilding plan and revised harvest strategy for St. Matthew blue king crab had recently been developed and it was initially hoped that the principals of the St. Matthew harvest strategy could be directly applied to a harvest strategy for Pribilof blue king crab. This alternative was eliminated for two reasons. The fishery manageability issue can be addressed by the minimum GHLs for fishery opening that are in the revised St. Matthew blue king crab harvest strategy and in the harvest strategy for Pribilof blue king crab that was recommended by the state. Additionally, further investigation into the histories of the St. Matthew and Pribilof blue king crab stocks, stock assessment, and fisheries indicated that separate and unique harvest strategies were needed for the two stocks to avoid overfishing of the Pribilof stock.

The second alternative that was initially considered was a plan that included a combined harvest strategy for Pribilof red king crab and Pribilof blue king crab. This alternative was initially of interest because the fisheries for Pribilof red and blue king crab had been prosecuted under a combined GHL during 1995-1998. However, uncertainties on the precision of Pribilof red king crab abundance estimates and the distributional overlap of blue and red king crab in the Pribilof District during the fishery season could not be resolved as needed within the timeframe required for adopting a rebuilding plan for Pribilof blue king crab. As a result, this alternative could not be analyzed.

Affected Environment

3.0 Description of the Affected Environment

NEPA requires a description of the physical, biological and socio-economic environment in which the proposed action is contained. The focus in describing this environment is in the relationship of these sectors of the environment to the Pribilof Islands blue king crab population and fishery. This description of the affected environment then sets the stage for the analysis of the proposed alternatives in Chapter 4. Please note that all tables are in section 8.0 of this document and all figures are in section 9.0 of this document.

3.1 Physical Environment of the Pribilof Islands Marine Area

The Pribilof Island chain lies on the southeast Bering Sea shelf near the shelf break. The chain is an archipelago of five islands, the largest of which, St. Paul and St. George, make up over 97% of the total land area. The Pribilof Islands are the only islands on the eastern Bering Sea shelf in proximity to the shelf break. The unique oceanographic conditions near the Pribilofs produce nutrient-rich, tidally-mixed waters which allow for a productive ecosystem that is home to large populations of marine mammals, seabirds, fish and crab populations.

Temperatures in the Pribilof range from a daily mean of over 10°C in August to lows below 0°C in April (Stabeno et al. 1999). Mean winds are weakest in the summer months, coming from the south, and strongest in the winter months when the prevailing wind direction is from the north (Stabeno et al. 1999). The climate is modified by variable sea ice cover. Sea ice is advected southward from where it forms in the northern Bering Sea (Overland and Pease 1982). While the extent of ice cover during the winter is highly variable and dependant largely on prevailing winds, sea ice is generally absent from the water around the Pribilofs from May through December (Stabeno et al. 1999).

The Pribilof Islands are uniquely situated near the shelf break. The bottom bathymetry shoals from over 3000 meters to less than 100 meters in close proximity to the islands. Most red and blue king crab fisheries occur at depths from 50 to 200 m. Nearshore bottom substrate around the Pribilof Islands are covered by thick shellhash, with some cobble and gravel (Armstrong et al. 1985). Crab depend on specific benthic habitat types throughout their juvenile and adult life stages, and settlement on habitat with adequate shelter, food, and temperature is imperative to the survival of first settling crab. Young of the year red and blue king crab require nearshore shallow habitat with significant protective cover (Stevens and Kittaka 1998). Juveniles have been associated with cobble habitat with shell hash (Armstrong et al., 1985). The thick cover of shellhash found around the Pribilof Islands may be a unique feature of this particular habitat region. The large populations of bivalves producing this shellhash are found in this area, and current patterns may be such that these empty shells are retained directly in the area (Armstrong et al. 1985).

Currents and tidal mixing near the Pribilofs result from the interaction of the eastern Bering Sea currents and tides with the bottom bathymetry in this region. This influences regional hydrography. A generalized depiction of the patterns and nature of currents and circulation in the eastern Bering Sea are described by Stabeno et al. (1999), Stabeno and Reed (1994) and Schumacher and Stabeno (1998) and shown in Figure 8. The Alaskan Coastal Current enters the EBS through both Unimak Pass and several major passes along the Aleutian Island chain (Reed and Stabeno 1999), and moves east onto the EBS shelf as a cyclonic (counterclockwise) gyre (Figure 8). Much of the Alaska Coastal Current that enters through Unimak Pass flows either northwest along the EBS shelf slope, as the Bering Slope Current, or continues in a slow

counterclockwise direction nearshore within the Coastal Domain along the north side of the Alaskan Peninsula to the end of Bristol Bay, and from there continues west-northwest (Figure 8).
Currents are important in the life history of crab as larval stages can be advected in the net direction of prevailing currents from their point of hatch. Current studies have shown a general northwest direction of prevailing currents and slow speeds along the shelf break past the Pribilof Islands (Figure 8) (Kinder and Schumacher 1981; Schumacher and Reed 1983) In order to retain larvae nearshore, local current patterns and eddies must be present to enhance settlement on the substrate in the region (Armstrong et al. 1985) Small-scale eddies and local tidal currents with little net displacement have been studied around these islands and other regional bathymetric features (Stabeno et al. 1999) (Figure 9). Drifters deployed to measure direction and speed of currents around such islands are often entrained in clockwise circulation close to shore in repeated rotations, which suggests that larvae could remain in close proximity during pelagic development and settle nearshore around such islands.

The combination of the above parameters produces a physical environment in the Pribilof Islands which is distinct from the surrounding region. In summary, the islands are situated in a nutrient-rich area, with strong tidal-mixing near the shelf break, the shellhash substrate important to the survival of juvenile crabs is locally produced and retained, and prevailing regional currents and eddies may assist in retaining crab larvae in this area.

3.2 Biological Environment

This section describes the interacting components of the biological environment in the Pribilof Islands region. In addition to describing the biology of the blue king crab (3.2.1), the groundfish fisheries, marine mammals, seabirds and other species are described as well as the Essential Fish Habitat (EFH) surrounding the Pribilof Islands region.

3.2.1 Biology of blue king crab

Blue king crabs are anomurans of the family lithodidae that includes king crabs as well as other crabs that share an evolutionary history stemming from the right handed hermit crabs (paguridae, see Cunningham et al. 1992). Blue king crabs are found from Hokkaido waters, with disjunct populations occurring in the Sea of Okhotsk and along the Siberian coast to the Bering Straits. They are known from the Diomede Islands, Point Hope, outer Kotzebue Sound, King Island, and the outer parts of Norton Sound. Subsistence fisheries occurred for them in all these North American localities. In the remainder of the Bering Sea, substantial populations that have supported commercial exploitation occur at St. Matthew Island and in the Pribilof Islands. North American fisheries differ from the Asian fisheries in that almost all occur along continental coasts. In more southerly areas as far as southeastern Alaska in the Gulf of Alaska, blue king crabs are found in disjunct, widely-separated populations that are frequently associated with fjord-like bays.

Blue king crab are similar to better known red king crab, but are typically biennial spawners with lesser fecundity and somewhat larger sized (*ca.* 1.2 mm) eggs (Somerton and Macintosh 1983; 1985; Jensen et al. 1985; Jensen and Armstrong 1989; Selin and Fedotov 1996). Red king crab are annual spawners with relatively higher fecundity and smaller sized (*ca.* 1.0 mm) eggs. Ecologically the two species apparently are very similar. Differences between the two species are given in Table 5. The lower reproductive potential of blue king crab is interesting from an oceanographic perspective since blue king crab populations form concentrations around offshore islands in the eastern Bering Sea (EBS) (Figure 3 of Section 2.2.1). Presumably, either localized transport mechanisms or demersal larval behavior might be involved in maintaining these populations of blue king crab. The larger size of blue king crab larvae (Hoffman 1967) may enhance their swimming ability relative to red king crab and hypothetically help them to maintain their position relative to preferred habitat. Oceanographic data from these near-shore, island areas have been insufficiently described and larval surveys have been sporadic.

In the Pribilof District blue king crab occupy the waters adjacent to and northeast of the Pribilof Islands (Stevens et al. 200;, Armstrong et al. 1987). The disjunct, insular distribution of blue king crab relative to the more broadly distributed red king is likely the result of post-glacial period increases in water temperature that have limited the distribution of this cold-water adapted species (Somerton 1985). Factors that may be directly responsible for limiting the distribution include the physiological requirements for reproduction, competition with the more warm-water adapted red king crab, exclusion by warm-water predators, or habitat requirements for settlement of larvae (Somerton 1985, Armstrong et al 1985; 1987).

Juvenile stages of blue king crab show a strong association with the shell hash habitat that exists within 10-15 km of St. Paul Island and on a narrow ridge just east of St. George Island (Armstrong et al. 1985, 1987). That association suggests a habitat requirement for juvenile blue king crab in the Bering Sea that is limiting to the species' distribution. Armstrong et al. (1985; 1987) suggested that shell hash habitat was important to juveniles as a refuge from predators; juvenile blue king crab lack the long spines present on juvenile red king crabs and may have a greater requirement for the cover afforded by shellhash to avoid predators. Blue king crab juveniles in their first year of life often have white carapaces that blend in with shell hash. Later juvenile stages have a mottled color pattern that blends into the background epifauna. Unlike red king crab juveniles, blue king crabs are not known to form pods. Adult blue king crabs in the Pribilof Islands do not show the same restrictions to the nearshore habitat as juveniles (Palacios et al. 1985, Armstrong et al. 1987). Instead, adults show a seasonal distribution, with a high density in the nearshore areas to the east of St. Paul Island in spring and a more dispersed distribution in the offshore areas in the summer (Armstrong et al. 1987). The occurrence of nearshore aggregations of adults in the spring indicate a shoreward migration for egg hatching and mating and suggest the importance of the nearshore habitat around St. Paul Island for those purposes. Release of larvae in the nearshore areas and local current patterns and eddies may increase the chances for settlement and metamorphosis of megalopae in the nearshore shellhash habitat. However, conditions that would transport larvae away from the nearshore habitat probably occur at least occasionally, and such events would be expected to drastically reduce post-settlement survivorship (Armstrong et al. 1987).

Female size at 50% maturity for Pribilof blue king crab is estimated at 96-mm carapace length (CL) and size at maturity for males, as estimated from size of chela relative to CL, is estimated at 108-mm CL (Somerton and MacIntosh 1983). Those estimates of size at maturity for blue king crab in the Pribilof stock compare with estimates of 81-mm CL for females and 77-mm CL for males in blue king crab from the St. Matthew Island stock ((Somerton and MacIntosh 1983). The biennial reproductive cycle of blue king crab females has been attributed to a prolonged (greater than one year) embryonic period; estimated at 19 months (Sasakawa 1975a) and at 14-15 months (Somerton and MacIntosh 1985). Armstrong et al. (1985, 1987), however, estimated the embryonic period for Pribilof blue king crab at 11-12 months, regardless of previous reproductive history.

The 11-12 months estimated for the embryonic period indicates that it is the inability to produce a full ovary in one year, rather than a prolonged embryonic period, that is responsible for the biennial reproductive cycle of large female blue king crab (Jensen and Armstrong 1989). It may not be possible for large female blue king crabs to support the energy requirements for annual ovary development, growth, and egg extrusion due to limitations imposed by their habitat, such as poor quality or low abundance of food or reduced feeding activity due to cold water (Armstrong et al. 1987, Jensen and Armstrong 1989). Both the large size reached by Pribilof Islands blue king crab and the generally high productivity of the Pribilof area, however, argue against such environmental constraints. Here it is pertinent to note that red king crab in the Pribilof District are larger than their Bristol Bay counterparts and have a size at maturity similar to that found in Kodiak waters. Fecundity of female blue king crab varies with size, from approximately 100,000 embryos for a 100-110 mm CL female to approximately 200,000 for a female >140-mm CL (Somerton and MacIntosh 1985). The egg mass produced by a female blue king crab is 20-30% greater than that produced by a comparably sized red king crab (Jensen and Armstrong 1989). However, the blue king crab females requires two years to produce an egg mass 20-30% greater in size of that which a red king crab female produces in one year. Pribilof blue king crab molt, mate, and extrude their clutches in late March through mid April (Armstrong et al. 1987). The larval stage is estimated to last for 3.5 months to 4 months and larvae metamorphose and settle during August through early September (Armstrong et al. 1987).

3.2.2 Bycatch

This section discusses bycatch in the crab fisheries, groundfish fisheries and other shellfish fisheries.

3.2.2.1 Bycatch in crab fisheries

Blue king crab in the Pribilof District can occur as bycatch in the following crab fisheries: the eastern Bering Sea snow crab fishery, the eastern Bering Sea Tanner crab fishery, the Bering Sea hair crab (*Erimacrus isenbeckii*) fishery, and the Pribilof red and blue king crab fisheries. Of those fisheries, only the eastern Bering Sea snow crab fishery has remained open through 2002; the eastern Bering Sea Tanner crab fishery has been closed since 1997, the Pribilof red and blue king crab fisheries have been closed since 1999, and the Bering Sea hair crab fishery has been closed since 2001.

Annual bycatch of blue king crab during crab fisheries for the years 1995-2002 was estimated using data collected by on-board observers who are deployed under the State's crab fishery observer program (Table 6). Estimates in Table 6 are the sum of annual bycatch estimates for the eastern Bering Sea snow crab fishery, the eastern Bering Sea Tanner crab fishery, the Bering Sea hair crab fishery, and the Pribilof red and blue king crab fisheries. It should be noted that the bycatch estimate for the eastern Bering Sea snow crab fishery that we included as a component of the total bycatch estimate includes bycatch from the St. Matthew Section.

Although St. Matthew blue king crab account for the majority of blue king crab captured in the snow crab fishery (D. Barnard, ADF&G, Kodiak, *personal communication*), the total bycatch of blue king crab in the snow crab fishery is relatively low (estimated at <25,000 crabs annually during 1995-2002). Accordingly, we made no attempt to split out St. Matthew blue king crab from the estimate for the snow crab fishery. It should also be noted that only limited data is available for estimating bycatch in the Pribilof king crab fisheries that occurred during 1995-1998. Observers have been mandatory on all catcher-processor vessels participating in BS/AI king and Tanner crab fisheries since 1988 and all catcher-processor vessels participating in the eastern Bering Sea snow crab fishery since 1991 (Boyle and Schwenzfeier 2002). Additionally, observers have been required on all vessels fishing in the Bering Sea hair crab fishery since 1993. However, there was no program for gathering bycatch data from catcher-only vessels participating in the BS/AI king, Tanner, and snow crab fisheries, and it was not implemented until 2000, subsequent to the closures of the eastern Bering Sea Tanner crab fishery in 1997 and the Pribilof king crab fishery in 1999. Due to low participation of catcher-processor vessels in the Pribilof king crab fishery, bycatch data from the Pribilof king crab fishery for 1995-1998 is available from only one vessel in a single season. Bycatch data from the 1998 CDQ fishery that followed the 1998 Pribilof king crab general ("open-access") fishery is available, however. As such, bycatch estimates from the fishery during 1995-1998 that would be expected to account for a significant portion of the total bycatch – the Pribilof king crab fishery itself – are either unavailable or of low precision.

Given the discussion on data availability, above, it is difficult to comment on bycatch levels during the 1995-1998 crab fisheries. However, since 1999 the observer coverage on fisheries that remained open (the eastern Bering Sea snow crab and Bering Sea hair crab fisheries) was sufficient to provide reliable estimates of blue king crab bycatch. Those estimates indicate that total bycatch in the crab fisheries during 1999-2002 was 1% or less of the total population abundance estimate; in the last two years bycatch estimates represented less than 0.1% of the total population abundance estimate.

Bycatch mortality during crab fisheries was estimated by multiplying the bycatch estimates by the 8% discard mortality rate that has been used in previous analyses for crab pot fisheries (NPFMC 2000). Since 1999, bycatch mortality in the crab fisheries is estimated to account for 0.0% to 0.1% of the annual total population abundance estimate (Table 7).

3.2.2.2 Bycatch of blue king crab in groundfish fisheries

The bycatch of crab in the directed groundfish fisheries is another source of crab mortality to be considered in a rebuilding plan. Crab bycatch in the groundfish fisheries is estimated by the National Marine Fisheries Service through the groundfish Observer Program (Queirolo et al. 1995). Bycatch numbers for blue king crab are combined with golden king crab and scarlet king crabs into an "other king crab" category. Observer coverage depends on vessel length; 100% observers on vessels > 125 feet, 30% coverage on vessels 60-125 feet, and 0% coverage on vessels <60 feet. Shoreside processors have 100% coverage. 100% coverage means that an observer is always onboard; it does not mean that every haul or landing is observed.

Bycatch (numbers) of "other king crab" in groundfish fisheries in areas 521 and 513, and current years survey abundance estimate for Pribilof Island blue king crab

Year	Bycatch	Abundance (millions)	Bycatch as %
1995	7,275	8.4	0.09
1996	7,044	7.0	0.10
1997	3,420	4.1	0.08
1998	24,153	4.3	0.56
1999	14,720	3.2	0.46
2000	8,624	2.2	0.39
2001	4,939	2.2	0.22
2002	6,686	1.5	0.45

Bycatch of blue king crab in groundfish fisheries is small relative to total population abundance. Bycatch of "other king crabs" is reported from the Pribilof District in 7 different statistical regulatory areas in the Bering Sea and Aleutian Islands region. These regulatory areas are 513, 514, 517, 518, 521, 523 and 524. However, based upon NMFS trawl survey data and location of captured blue king crab from 1995-2002, the population is concentrated in areas 513 and 521 (Figure 2). Bycatch data from these two regions are shown from 1995 -2002.

While some "other king crab" bycatch is found in the regions not being considered, these regions can be disregarded for their contribution to Pribilof Island blue king crab bycatch due to the low probability of the bycatch containing Pribilof Islands blue king crabs. For area 524, the bycatch of "other king crab" is most likely coming from the St. Matthew Island section. There have been no records of blue king crab captures within Area 517 during the NMFS EBS trawl survey or during crab fisheries since at least 1995, thus all "other king crab" caught here is likely brown /golden king crab. Area 514 can also be disregarded as it skirts only the northern most fringe of the Pribilof Islands blue king crab distribution, and since 1995 only 4 Pribilof Island blue king crab have been caught there in the NMFS EBS trawl survey. The majority of area 514 does not overlap with the Pribilof Island blue king crab distribution. This leaves areas 521 and 513 as the statistical areas with the highest likelihood to contain Pribilof Island blue king crab as bycatch in the reported “other king crab” bycatch category.

Bycatch in the groundfish fishery has been a low percentage of the total population (see table above). In most years the bycatch has been less than 0.5% of the total abundance. The highest bycatch numbers were for the years 1998 and 1999. These numbers were higher in the fixed gear sector for both years. In 1998, the majority of the crabs were caught by fixed gear in area 513, while in 1999 the majority were caught by fixed gear in area 521.

The bycatch numbers listed are most likely an overestimate of the actual bycatch of Pribilof blue king crabs due to the inclusion of area 521 in the bycatch estimates. Area 521 covers some slope area, which is the habitat for brown king crab, and also overlaps much of the St. Matthew blue king crab distribution area. Thus the “other king crab” numbers listed for this region likely contain a large percentage of brown king crab as well as St. Matthew blue king crab, and are therefore likely to represent an overestimate of the actual Pribilof Islands blue king crab bycatch.

Even so, the bycatch as listed is not substantial and represents a very low amount relative to the abundance of crabs in this area. Bycatch mortality rates were calculated using mortality rates of 37% for hook and line, 8% for pot and 80% for trawl. The results are shown in the adjacent table.

Bycatch mortality for all gear types of “other king crab” in groundfish fisheries in areas 521 and 513, and current years survey abundance estimate for Pribilof Island blue king crab.

Year	**Bycatch mortality**	**Abundance (millions)**	**Mortality as %**
1995	5,160	8.4	0.06
1996	2,395	7.0	0.03
1997	1,656	4.1	0.04
1998	3,515	4.3	0.08
1999	1,931	3.2	0.06
2000	2,253	2.2	0.07
2001	1,484	2.2	0.07
2002	2,181	1.5	0.15

Bycatch mortality has ranged from 1,484 crabs to 5,160 crabs during the 1995-2002 period. Assuming all "other king crabs" were blue king crabs, this still equates to the highest mortality (in 2002) of less than 0.15% with less than 0.08% mortality in most years. From a mortality standpoint, this is much lower on average than the mortality associated with other groundfish fishery PSC species such as herring (1%), halibut (1.3% trawl and longline combined), chum salmon (<1%), and chinook salmon (2%-4%) (Witherell et al. 2000).

3.2.2.3 Bycatch of blue king crab in other fisheries

Bycatch or potential for bycatch in three state-managed shellfish fisheries prosecuted in the Bering Sea was also examined: the weathervane scallop fishery, snail fishery, and shrimp fishery. In each case, bycatch concerns are low to non-existent.

No blue king crab have been recorded as bycatch in the scallop dredge fishery (G. Rosenkranz, ADF&G, Kodiak, *personal communication*), although 100% observer coverage has been required on scallop-fishing vessels since 1993 and roughly 1/3 of all tows performed are sampled for bycatch by observers (Barnhart and Rosenkranz 2003). The Bering Sea scallop fishery occurs to the southeast of the distribution of the Pribilof blue king crab stock (Barnhart and Rosenkranz 2003) and scallop fishing is prohibited within the Pribilof Islands Habitat Conservation Area by state regulation (ADF&G 2002b).

The pot fishery for snails in the Bering Sea has been prosecuted sporadically by five or less participating vessels since 1992; there has been no reported harvest since 1997 (ADF&G 2002a). Observer coverage was required on all vessels fishing for snails in the Bering Sea west of 168º W longitude in 1993. Bycatch sampling performed by those observers indicates that less than 1,000 female and sublegal male blue king crab were captured during the entire 1993 season; only 15 sublegal male and 9 female blue king crab were observed in the contents of 1,353 sampled pots (Tracy 1995).

Over the last two decades shrimp trawl fishery effort in the Bering Sea has been sporadic. Since 1980 landings have been reported for only five years, most recently in 1999. ADF&G closed the shrimp trawl fishery in the Bering Sea after the 1999 season pending additional resource information. There is no bycatch data available from the fishery and recent harvests are confidential due to low participation. However, potential for bycatch of Pribilof blue king crab in the Bering Sea shrimp trawl fishery, were it to reopen, is very low. Although the waters around the Pribilof Islands are not closed to trawl shrimp, there has not been any trawl shrimp harvest in the Pribilof Islands Habitat Conservation Area. The annual NMFS Eastern Bering Sea trawl survey indicates the majority of the trawl shrimp resource exists north and west of the Pribilof Islands. Historic fishery data show harvests have been mainly north and west of the Pribilof Islands, on or near the continental slope.

3.2.3 Groundfish stocks and fisheries

Groundfish fisheries which occur in the same species general distribution as the blue king crab fishery include: Pacific cod, pollock, Arrowtooth flounder, Atka mackerel, yellowfin sole, rock sole, flathead sole, skates, and sculpins (NPFMC 1999). Bycatch of blue king crab in these fisheries is low (section 3.2.2.2). Since the implementation of the Pribilof Islands Habitat Conservation area, the overlap between the flatfish trawl fisheries and the blue king crab fishery has declined (section 2.2.3.1). Very little is known about the trophic interaction of blue king crab, however similar trophic interactions are presumed as for red king crab. A number of fish species are known to feed on larval red king crab, including Pollock, Pacific herring, sockeye salmon, and yellowfin sole. Once the crab settle on the sea floor, they are prey to a number of commercial and non-commercial fish species such as most flatfish species, halibut, sablefish, skates, sculpins, and other benthic invertebrates, such as sea stars. A high rate of cannibalism by juvenile red king crab on younger crab also exists. Studies have documented that Pacific cod consume soft-shelled female adult red king crab. A discussion of the specific trophic interactions between blue king crab and groundfish and other species is contained in the following section.

3.2.3.1 Predator/prey relationships and relative changes

There are very few records of blue king crab identified in stomach analysis. NMFS stomach analysis records show only 34 stomachs from the EBS that contained blue king crab as prey. Mean prey weights were as follows:

Pacific cod (2)	*Gadus macrocephalus*	303.524 g/crab
Walleye pollock (25)	*Theragra chalcogramma*	0.005 g/crab
Yellowfin sole (8)	*Pleuronectes asper*	0.007 g/crab

All of the above observations were taken from June to August during the NMFS summer bottom trawl survey for crab and groundfish in the eastern Bering Sea. Additionally, Pacific cod have been observed to feed on molting adult female blue king crabs in February (NMFS unpublished). The size of crabs in stomachs of yellowfin sole and walleye pollock clearly indicates predation on larvae and very early juveniles. Cod seem to prey on juveniles and adults as well. Sampling has been somewhat limited for blue king crab, but it seems very likely that the same set of species that prey other king and Tanner crabs would prey on blue king crab. We can probably include red king crab predators, such as skates (*Raja spp*), several sculpins (cottidae), northern rock sole (*Lepidopsetta polyxystra*), Alaska plaice (*Pleuronectes quadratuburculatus*), flathead sole (*Hippoglossoides elassodon*) and Pacific halibut (*Hippoglossus stenolepis*), as predators of blue king crabs. Coincident with the stock decline of Pribilof blue king in the early 1980s, the abundance of cod and flatfishes increased dramatically in the late 1970s and early 1980s and has generally been high ever since; the influx of rock sole in the Pribilof Islands area has been particularly spectacular. A cause and effect relationship between the decline in Pribilof blue king crab stock and the increase in the stocks of groundfish that are predators of and competitors with (see below) blue king crab remains speculative, however. Kruse and Zheng (1999) examined the time series of abundance and year class indices of the Pribilof blue king, EBS Pacific cod, EBS yellowfin sole, and EBS rock fish stocks for correlations consistent with any of three hypotheses: 1) Increased predation by groundfish caused declines in crab recruitment; 2) Physical forcing caused inverse responses in recruitment of crab and groundfish recruitment; and 3) Declines in crab abundance preceded species replacement by groundfish. After lagging the time series of indices for hatching or spawning as appropriate for each hypothesis and accounting for autocorrelation in the time series of indices, no correlations were significantly less than zero, providing no support for any of the three hypotheses. Although further, more detailed studies investigating more complex, non-linear relationships or spatial effects may reveal support for one of the three hypotheses, at this time we cannot conclude that groundfish predation or competition account for the decline in the Pribilof blue king crab stock.

Blue king crabs from the Koryak coast and the Gulf of Anadyr were found to consume polychaets echinoderms and molluscs in various proportions for differing area and crab size (carapace width, CW, Tarverdieva 1979) as follows:

	Percent of Diet		
	Gulf of Anadyr	Koryak Coast	
Food type	71 - 126 mm CW	71-130 mm CW	> 130 mm CW
Polychaets	50.0	34.0	23.7
Echinoderms	14.3	46.4	51.3
Molluscs	19.1	---	13.1
Not specified	16.4	19.8	11.9

Echinoderms included sea urchins (*Strongylocentrotus drobachiensis*), sand dollars (*Echinaracnius parma*) and brittle stars (*Ophiura sarsi*, *Ophiopholis sp*). Molluscs included univalves (Trochidae, Natacidae) as well as bivalves (Yoldia, Nuculana, Nucula, Astarte, Venericardia , Macoma, Hiatella, Serripes, Clinocardium and Spisula. Specific polychaets were not named. All these food items are common in the Pribilof Island area and are presumably eaten by blue king crabs there as well. These items are prominent in the diet of red king crab, which illustrates the ecological similarity between these two species of king crab. Most of these food items also occur in the diets of flatfishes listed above, which illustrates that there in competition for food as well as predation involved in interspecific relationships between those flatfishes and king crabs.

Blue king crabs are subject to two potentially fatal diseases including a herpes-type viral disease of the bladder and systemic infections by a microsporidian of the genus *Thelohania* (Sparks and Morado 1985, 1986). Prevalence of these diseases during the early 1980s, as well as their general nature, suggests that they could cause considerable mortalities. A rickettsial disease was described from a blue king crab collected near St Lawrence Island in 1982 (Johnson 1984), but this is the only know occurrence. In fjord-like habitats of southeastern Alaska, blue king crabs populations have high prevalence of parasitic barnacles (rhizocephalans) identified as *Briarosaccus callosum* (Shirley et al 1995; Hawkes et al 1985). In Olga Bay, Kodiak Island, blue king crab are infected by a different, unidentified rhizocephalan that is known only from microscopic study (Johnson et al 1986). Although *Briarosaccus callosum* commonly occurs on golden king crab in the Pribilof Canyon, there is no record of rhizocephalan infections of blue king crab in the eastern Bering Sea.

3.2.4 ESA Protected Species

The following section describes the protected species which occur in the BSAI crab management area. These protected species include Endangered Species Act (ESA)-listed Marine Mammals (section 3.2.4.1), other Marine Mammals (section 3.2.4.2), ESA-listed Pacific salmon and leatherback sea turtles (section 3.2.4.3), and ESA-listed seabirds (3.2.4.4). Twenty-four species occurring in the BSAI crab management area are currently listed as endangered or threatened under the ESA. The group includes seven great whales, one pinniped, twelve Pacific salmon, two seabirds, one albatross, and one sea turtle. This section describes these listed species because they occur in the action area and therefore may be affected by the proposed action. The purpose of this section is to establish context to evaluate the effects of the proposed action on these species.

Species currently listed as endangered or threatened under the ESA and occurring in the or BSAI crab management areas:

Common Name	Scientific Name	ESA Status
Northern Right Whale	*Balaena glacialis*	Endangered
Bowhead Whale	*Balaena mysticetus*	Endangered
Sei Whale	*Balaenoptera borealis*	Endangered
Blue Whale	*Balaenoptera musculus*	Endangered
Fin Whale	*Balaenoptera physalus*	Endangered
Humpback Whale	*Megaptera novaeangliae*	Endangered
Sperm Whale	*Physeter macrocephalus*	Endangered
Steller Sea Lion	*Eumetopias jubatus*	Endangered
Snake River Sockeye Salmon	*Onchorynchus nerka*	Endangered
Snake River Fall Chinook Salmon	*Onchorynchus tshawytscha*	Threatened
Snake River Spring/Summer Chinook Salmon	*Onchorynchus tshawytscha*	Threatened
Puget Sound Chinook Salmon	*Onchorynchus tshawytscha*	Threatened
Lower Columbia River Chinook Salmon	*Onchorynchus tshawytscha*	Threatened
Upper Willamette River Chinook Salmon	*Onchorynchus tshawytscha*	Threatened
Upper Columbia River Spring Chinook Salmon	*Onchorynchus tshawytscha*	Endangered
Upper Columbia River Steelhead	*Onchorynchus mykiss*	Endangered
Snake River Basin Steelhead	*Onchorynchus mykiss*	Threatened
Lower Columbia River Steelhead	*Onchorynchus mykiss*	Threatened
Upper Willamette River Steelhead	*Onchorynchus mykiss*	Threatened
Middle Columbia River Steelhead	*Onchorynchus mykiss*	Threatened
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Short-tailed Albatross	*Phoebaotria albatrus*	Endangered
Spectacled Eider	*Somateria fishcheri*	Threatened
Steller Eider	*Polysticta stelleri*	Threatened

NMFS is the expert agency for ESA listed marine mammals. The USFWS is the expert agency for ESA listed seabirds. NMFS consults on fisheries management actions that may effect marine mammals with NMFS - Protected Resources Division. For fisheries management actions that may effect seabirds, NMFS consults with USFWS. NMFS prepared two biological assessments to assess the effects of the crab BSAI crab fisheries on these listed species (NMFS 2000, NMFS 2002). These biological assessments, as well as the consultation history, are described below.

3.2.4.1 Marine Mammals

The marine mammal species listed as endangered or threatened under the ESA are the northern right whale, the bowhead whale, the blue whale, the fin whale, the sei whale, the humpback whale, the sperm whale, the western and eastern populations of Steller sea lions. In 1990, NMFS conducted a section 7 consultation on the FMP for the endangered humpback whale, blue whale, sei whale, fin whale, bowhead whale, right whale, sperm whale, and the threatened Steller sea lion. NMFS concluded that the BSAI commercial king and Tanner crab fisheries are not likely to adversely affect these endangered or threatened species or their critical habitat.

NMFS reinitiated consultation for the FMP because the change in listing for Steller Sea Lions from threatened to endangered and the designation of Steller Sea Lion critical habitat. In 2000, NMFS prepared a biological assessment for the BSAI crab FMP that assesses the effects of the crab fisheries on these species of marine mammals and their critical habitat (NMFS 2000). The biological assessment reviews the current status of the endangered species of marine mammals, the critical habitat designated for Steller sea lions, the environmental baseline for the action area, and the effects of the crab fisheries prosecuted under the FMP. The research presented in the biological assessment indicates that crab do not interact with any of the listed species of marine mammals. Crab do not comprise a measurable portion of the diet of any of the listed marine mammals. Furthermore, the crab species target by the fishery live in deep waters far from shore. Limited direct interactions between the crab fisheries and marine mammals have been reported. This is most likely due to the nature of pot gear, the time of the crab fisheries (in the fall and winter), and the location of the fisheries (far from shore). NMFS Sustainable Fisheries concluded that the actions considered in the Biological Assessment are not likely to (1) result in the direct take or compete for the prey of the seven large protected whale species or the western and eastern population of Steller sea lions, or (2) destroy or adversely modify designated Steller sea lion critical habitat. NMFS protected resources concurred with this determination, and concluded a formal consultation is not required (NMFS 2001c). Therefore, this biological assessment is incorporated by reference and it is not necessary to repeat the information in this EA.

3.2.4.2 Other Marine Mammals

The king and Tanner crab fisheries in the BSAI are classified as Category III fisheries under the Marine Mammal Protection Act. A fishery that interacts only with non-strategic stocks and whose level of take has an insignificant impact on the stocks is placed in Category III. An observer program has been in existence since 1988 for the Alaskan crustacean pot fisheries. No marine mammal species have been recorded as taken incidentally in the fisheries according to records that date back to 1990. Since no evidence indicates a plausible interaction between the crab fisheries and marine mammals, they will not be further discussed in this EA.

3.2.4.3 Pacific Salmon and Leatherback Sea Turtles

NMFS Sustainable Fisheries, with an addendum to the 2000 Biological Assessment for the king and Tanner crab FMP, included all listed species of salmon and Leatherback sea turtles in the informal section 7 consultation (NMFS 2001b). After reviewing the current status of the endangered and threatened species of salmon and the endangered Leatherback sea turtle, the environmental baseline for the action area, the effects of the crab fisheries prosecuted under the FMP, NMFS Sustainable Fisheries Alaska Region concluded that the actions considered, as proposed, would not adversely impact listed salmon species or Leatherback sea turtles in the action area. Therefore, NMFS Sustainable Fisheries believes formal consultation is not required. NMFS Protected Resources concurred with this determination (NMFS 2001c).

Since no evidence indicates a plausible interaction between the crab fisheries and these species, they will not be further discussed in this EA.

3.2.4.4 Seabirds

The seabird species listed as endangered under the ESA are short-tailed albatross, spectacled eider, and Steller's eider. In 1994, NMFS prepared a Biological Assessment for the king and Tanner crab FMP, which analyses the potential takes of listed seabirds in these fisheries and conducted an informal Section 7 consultation with USFWS (NMFS 1994). According to the Biological Assessment, the crab fisheries are not known to result in any significant impact to the short-tailed albatross, Steller's eider, or Spectacled eider. Nor do the fisheries compete for any crab species commonly preyed upon by marine birds. NMFS determined that the crab fisheries will have no adverse impact on any listed seabird nor will they delay in any way the recovery of those species, except the snow crab fishery which may adversely impact the Spectacled Eider.

Between 1994 and 1998, NMFS consulted with the USFWS annually on the crab FMP, which includes the winter Bering Sea snow crab fishery, pursuant to section 7 of the ESA (USFWS 1996a, 1996b). In the past, section 7 consultations on this fishery have been formal because it was perceived that the fishery was likely to adversely affect spectacled eiders. This perception of a likelihood of an adverse effect resulted from: (1) a lack of knowledge concerning the at-sea range of spectacled eiders and; (2) a lack of knowledge of the species of eiders that have struck, or were likely to strike crab vessels.

Beginning in 1995, observers aboard crabbing vessels received training in bird identification and reporting. Observers were instructed to report all sightings of spectacled eiders to the USFWS either directly or through ADF&G. To date, no take of spectacled eiders associated with this fishery has been reported.

ADF&G continues to place crab fishery observers onboard vessels participating in this fishery, and in the future, these vessel observers will continue to receive training and refresher training in seabird identification and seabird reporting procedures.

In February 2001, FWS designated critical habitat for Stellar's eider and spectacled eider, thus requiring reinitiating the section 7 consultation under 50 CFR Section 402.16. The FWS published the final determination of critical habitat for the spectacled eider and Alaska-breeding population of the Steller's eider in the Federal Register (66 FR 9146, 66 FR 8850).

NMFS reinitiated consultation for the FMP due to the designation of critical habitat for Stellar's eider and spectacled eider. In 2002, NMFS prepared a biological assessment for the BSAI crab FMP that assesses the effects of the crab fisheries on these seabirds and their critical habitat (NMFS 2002). The biological assessment identified how BSAI crab fisheries may directly or indirectly affect seabird populations and critical habitat. This biological assessment identifies that the only plausible biological interaction between the crab fisheries and threatened and endangered species is vessel strikes by seabirds. While such interactions are possible, the available evidence is not sufficient to argue persuasively that these interactions do occur in today's fisheries to an extent that limits the recovery of listed species occurring in the action area. The BA recommends enhanced observer reporting procedures to better document when strikes occur or do not occur. These observer reporting procedures were implemented in the fall of 2002 (ADF&G 2002b).
After reviewing the current status of the short-tailed albatross, the spectacled eider, and Steller's eider, the critical habitat designated for the spectacled eider and Steller's eider and the potential effects of the crab fisheries prosecuted under the FMP, NMFS concluded that the actions considered in the Biological

Assessment, are not likely to (1) adversely affect the listed seabirds, or (2) destroy or adversely modify designated critical habitat. USFWS concurred with NMFS' determination, and concluded a formal consultation is not required (USFWS 2003). Therefore, this biological assessment is incorporated by reference and it is not necessary to repeat the information in this EA.

3.2.5 Essential Fish Habitat

Section 303(a)(7) of the Magnuson-Stevens Act requires all FMPs to describe and identify EFH , which it defines as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." In addition, FMPs must minimize effects on EFH caused by fishing and identify other actions to conserve and enhance EFH. Groundfish and blue king crab fisheries occur within essential fish habitat (EFH) for a number of fish and invertebrate species. In the Bering Sea, EFH includes those identified for pollock, Pacific cod, many flatfish species, other groundfish species, red king crab, Tanner crab, and snow crab.

On January 20, 1999, the Council's five FMPs (BSAI and GOA groundfish, salmon, crab, and scallops) were amended to incorporate EFH provisions. These provisions included identification and description of EFH including habitat areas of particular concern, identification of research and information needs, and identification of potential adverse effects on EFH due to fishing and non-fishing activities. Additional information on EFH can be found in the EA for Amendments 55/55/8/5/5 (NPFMC 1999 - copies of this document can be obtained from the Council office upon request). A supplemental EIS (SEIS) for EFH is currently being prepared, following which the Council's five FMP's will be amended to incorporate additional EFH provisions as necessary. Additional info on blue king crab EFH will be available when the EFH SEIS is completed.

The current EFH definitions adopted for blue king crab life stages are listed below:

Egg - Level 0b, Level 1 and Level 2 (Figure 10a)
Same as Mature. Essential habitat for eggs is known for the stock of blue king crab in the Pribilof Islands based on general distribution (level 1) and density (level 2) of egg bearing female crabs. Essential habitat for eggs of the St. Matthew Island blue king crab stock is based on general distribution (level 1) of the egg bearing females. Essential habitat for eggs of the St. Lawrence Island blue king crab stock is inferred from incidental catch of mature female crab.

Larvae - Level 0c and Level 1 (Figure 10b)
No EFH definition determined for the St. Matthew Island and St. Lawrence stocks.
Blue king crab larvae spend 3.5 to 4 months in pelagic larval stages before settling to the benthic life stage. Larvae are found in waters of depths between 40 to 60 m. Essential habitat of larval blue king crab of the Pribilof Islands stock is defined using the general distribution (level 1) of larvae in the water column. Information to define essential habitat is not available for the St. Matthew Island and St. Lawrence Island stocks of larval blue king crab.

Early Juvenile - Level 0c and Level 2 (Figure 10c)
No EFH definition determined for the St. Matthew and St. Lawrence Island stocks. Early juvenile blue king crabs require refuge substrate characterized by gravel and cobble overlaid with shell hash, and sponge, hydroid and barnacle assemblages. These habitat areas have been found at 40-60 m around the Pribilof Islands. Essential habitat of early juvenile blue king crabs is based on general distribution (level 1) and

density (level 2) of this life stage in the Pribilof Island stock. Information to define essential habitat for early juvenile blue king crabs in the St. Matthew Island and St. Lawrence Island stocks is not available.

Late Juvenile - Level 0c, Level 1 and Level 2 (Figure 10d)
No EFH definition determined for the St. Lawrence Island stock.
Late juvenile blue king crab require nearshore rocky habitat with shell hash. Essential habitat is based on general distribution (level 1) and density (level 2) of late juvenile blue king crab of the Pribilof Islands stock. General distribution (level 1) of the late juvenile blue king crabs is used to identify essential habitat for the St. Matthew Island stock. Information is not available to define essential habitat for the St. Lawrence Island stock of late juvenile blue king crab.

Mature - Level 1 and Level 2
Mature blue king crabs occur most often between 45-75 m depth on mud-sand substrate adjacent to gravel rocky bottom. Female crabs are found in a habitat with a high percentage of shell hash. Mating occurs in mid-spring. Larger older females reproduce biennially while small females tend to reproduce annually. Fecundity of females range from 50,000-200,000 eggs per female. It has been suggested that spawning may depend on availability of nearshore rocky-cobble substrate for protection of females. Larger older crabs disperse farther offshore and are thought to migrate inshore for molting and mating. General distribution (level 1) and density (level 2) of mature blue king crab are used to identify essential habitat for the Pribilof Islands and St. Matthew Island stocks. Essential habitat of mature blue king crab is based on distribution (level 1) data for the St. Lawrence Island stock.

Given the current status of Pribilof Islands blue king crab, it seems reasonable that the importance of blue king crab EFH in maintaining stock productivity should be a priority message contained in consultations on any proposed activities. To the extent feasible and practicable, this area should be protected from adverse impacts. The interim final rule for EFH states the following in the case of an overfished stock: "If a species is overfished, and habitat loss or degradation may be contributing to the species being identified as overfished, all habitats currently used by the species should be considered essential in addition to certain historic habitats that are necessary to support rebuilding the fishery and for which restoration is technologically and economically feasible. Once the fishery is no longer considered overfished, the EFH identification should be reviewed, and the FMP amended, if appropriate." Therefore, EFH for the Pribilof Islands blue king crab should be considered as all habitats used by this stock, at least until such a time as the stock is above MSST. The blue king crab fishery does not occur on any areas designated as Habitat Areas of Particular Concern (HAPC).

3.2.6 Ecosystem Considerations

The marine food-web of North Pacific marine fishes are complex (Livingston and Goiney 1983). Numerous species of plankton, phytoplankton, invertebrates, mollusks, crustaceans, forage fish, demersal, mid-water, and pelagic fish, marine mammals, seabirds, and humans combine to comprise the food-web present in the BSAI and GOA. Environmental changes as well as human exploitation patterns can effect changes to trophic interactions. Fishing causes direct changes in the structure of benthic communities by reducing the abundance of target or by-catch species, then these reductions may lead to responses in non-target species through changes in competitive interactions and predator prey relationships. Indirect effects of fishing on trophic interactions in marine ecosystems may also occur. Current debates on these topics include comparing relative roles of "top down" (predator) or "bottom up" (environmental and prey) control in ecosystems and the relative significance of "donor controlled" dynamics (in which victim populations influence enemy dynamics but enemies have no significant effect on victim populations) in the food webs (Jennings and

Kaiser 1998.). Specific predatory/prey and other trophic interactions with blue king crab is described in section 3.2.3.

3.3 Human Environment

The following section contains a general description of the crab fishing fleet for the Pribilof blue king crab fisheries, and the two communities most impacted by this industry; St. Paul and St. George. More information on the overall BSAI-wide crab fishery and fishing industry is provided in the Crab FMP, the Crab Stock Assessment and Fishery Evaluation (SAFE) reports (e.g., NPFMC 2002), and the annual area management reports produced by ADF&G. Copies of these documents are available on request from the Council office. Additional information on the crab fishery, fishing industry and the potential impacts upon these of the proposed crab rationalization program will be available in the forthcoming EIS for crab.

3.3.1 Description of the Fishery

This section provides general background information concerning the participation patterns of vessels harvesting crab in the BSAI fisheries from 1991 to 2000 (only the Pribilof blue king crab is presented here, additional crab fishery information is available in the upcoming EIS for crab).

During the late 1970's, landings of blue king crab from the Pribilof District increased to a peak of 11 million pounds in the 1980-1981 season. This was followed by a rapid decline, leading to a total closure of the fishery in 1988. The fishery remained closed from 1988-1994. In 1995 the stock had rebounded sufficiently to permit a combined red and blue king crab GHL of 2.5 million pounds. In 1995, the average weight of blue crab harvested was 7.3 pounds, total landed pounds was 1,154,386 and the ex-vessel price was $2.92 per pound. GHLs continued to decline according to the stock biomass over the next several years. By 1998, total landed pounds was 494,424, and the ex-vessel price was $2.34 (see below).

Weighted fish ticket prices for Pribilof Blue King Crab by season

Season	Total Landed Pounds	Total Value	Weighted Ex-vessel Price
1995	1,154,386	$3,120,211	$2.92
1996	909,713	$2,233,280	$2.66
1997	491,434	$1,337,639	$2.82
1998	494,424	$1,111,172	$2.34

Abundance of Pribilof blue king crabs continued to decline and in 1999 the fishery was closed due to low stock abundance. Additional concerns were raised regarding increased participation in the Pribilofs to unmanageable levels following the closure of the St. Matthew blue king crab fishery in 1999. The Pribilof blue king crab fishery has remained closed since 1999. The red king crab fishery in the Pribilofs has also remained closed due to concerns regarding blue king crab bycatch in the red king crab fishery.

Vessel participation in the blue king crab fishery has also declined. During the four years the fishery was open, qualified vessels declined from a high of 76 in 1995 to 35 in 1997. Non-qualified vessels declined

from a high of 42 in 1995 to 16 in 1998. The fishery is composed almost entirely of catcher vessels, with only one qualified catcher/processor having participated in the 1995 fishing season.
The Crab Vessel License Limitation Program (LLP):

The NPFMC approved LLPs for its Groundfish and Crab FMPs on June 17, 1995. The Secretary approved the proposed rule implementing the Groundfish and Crab LLPs on September 12, 1997. The final rule was approved on October 1, 1998. In 1998, the Crab LLP was further amended to include changes in the basic eligibility criteria for crab, in the form of additional recent participation criteria. These changes were adopted by the Council as Amendment 10 to the Crab FMP in October, 1998.

Fishing under the crab license limitation program (LLP) began in January 2000. Total LLP licences for the Pribilof District king crab fishery were 136 as of May, 2003. Of these 26 are interim licences. Interim licenses were issued if any part of a person's claim is contested. Interim licenses are temporary and the total numbers of licenses will decrease as interim licenses are denied or licenses are granted and made permanent. The number of LLP licenses provides an indication of the number of the maximum number of participants in the BSAI crab fisheries. The LLP license includes the mode of operation and the maximum length overall of the vessel on which the license may be used. Each crab LLP licenses carries one or more area/species endorsements. Approximately 80 % of the crab LLP licenses carry an endorsement for the Bering Sea *C. opilio* and *C. bairdi* fisheries. Approximately 80 % of crab LLP licenses also carry endorsements for the Bristol Bay red king crab fishery. Almost 50 % of the crab LLP licenses are endorsed for St. Matthew Island blue king crab, 36 % are endorsed for Pribilof Islands king crab, and less than 20 % of the licenses are endorsed for the Norton Sound king, Aleutian Islands red king, and Aleutian Islands golden king crab fisheries.

3.3.2 Existing Socioeconomic Conditions/Communities Impacted:

The following section describes the economy of the two communities most impacted by the king crab closures and subsequent rebuilding plan in the Pribilof Island blue king crab fishery; St. Paul and St. George. Additional communities such as Dutch Harbor and Kodiak are summarized briefly as they also historically process BSAI crab.

<u>St. Paul:</u>

The community of St. Paul is located on a narrow peninsula on the southern tip of St. Paul Island, the largest of five islands in the Pribilofs. St. Paul Island lies 47 miles north of St. George Island, 240 miles north of the Aleutian Islands, 300 miles west of the Alaska mainland, and 750 air miles west of Anchorage. St. Paul, located in the Aleutians West Census Area, is not part of an organized borough. The City of St. Paul, incorporated in 1971, encompasses 40.3 square miles of land and 255.2 square miles of water.

St. Paul is a supply and processing port for a portion of the Bering Sea groundfish and crab fleets. Major improvements to the harbor, including a dock expansion and breakwater, have allowed continual development of this community as a shipping and fishing town. There are fish processing plants, along with cold storage and warehouse facilities. The local fleet fishes primarily for halibut; local processor produce crab and several species of groundfish.

The federally controlled fur seal industry dominated the economy of St. Paul until the mid-1980s. The presence of large seal populations still contributes to the local economy, as the rookeries and more than 210 species of nesting sea birds attract almost 700 tourists annually, and the community is working to further develop eco-tourism. Residents utilize halibut, fur seals, reindeer, marine invertebrates, plants, and berries for subsistence.

The overall importance of the commercial fishery to the community may be seen in the fact that the local raw fish tax is the largest single local source of funds for the City of St. Paul. In terms of the relative importance of crab, opilio is by far the most important commercial species, crab or non-crab, for St. Paul processors and thus for revenues for the City of St. Paul.

In recent years, economic activity associated with harbor development in the support of commercial fishing has been quite important, and especially so in conjunction with the local development of those fisheries. St. Paul, as a CDQ community, has a viable opportunity to partner with the fishing industry in these ventures. Summary information on local CDQ group-related employment is only available for 1994-1997 and ranged from 89 in 1994 to 15 in 1997, with average earnings ranging from $9,807 to $14,880 (CBSFA website: http://www.beringsea.com/communities/Saint_Paul/CBSFA/index.php). Due to the recent drastic reduction in opilio crab stocks (and quotas), St. Paul has also recently shared in the receipt of Opilio Crab Disaster Funds, as has the Aleut Community of St. Paul (the local IRA organization) and the Central Bering Sea Fisherman's Association (CBSFA).

The local fishing fleet focuses primarily on halibut in the local area (4C), although there is interest in expansion into other areas. About 31 community residents currently hold commercial fishing permits for halibut. Local fishermen are also interested in developing a local cod fishery and have sold a limited amount of cod caught as by-catch in the halibut fishery to various processors. Cod is not yet a target fishery for the local fleet, although its development is one of the long-term goals stated in the CBSFA's quarterly CDQ reports to the State of Alaska. The Trident plant in St. Paul has processed cod, although this cod was purchased primarily (or totally) from non-local boats. There are other fisheries of interest to the local fleet, such as the hair crab fishery.

The CDQ program, which was implemented in 1992 as part of the groundfish management changes of Inshore/Offshore-1, allocated a percentage of the pollock quota to CDQ communities to aid in economic development through involvement in Bering Sea commercial fisheries. St. Paul is the only community that is the sole member of its own CDQ group (the CBSFA). The CDQ program expanded in 1998 to a number of other species, including crab, in addition to pollock. The CBSFA is currently (2002) allocated the following percentages of the overall CDQ allocations – pollock 5 %, halibut (area 4C) 90 %, sablefish (Bering Sea) 18 %, turbot (Bering Sea) 14 %, turbot (Aleutian Islands) 5 %, Pribilof red and blue king crab 100 %, opilio crab (Bering Sea) 19 %, Bairdi tanner (Bering Sea) 19 %, Pacific cod 20 %, Atka mackerel 10 % yellowfin sole 8 %, most flatfish species 10 %, rockfish other than arrowtooth 8 %, Arrowtooth rockfish 9 %, most Pacific Ocean Perch species 10 %, and various percentages of prohibited species CDQ caps.

According to ownership data supplied by NPFMC, all crab deliveries to processors in the Pribilofs are made by non-local boats from other Alaskan communities and the Pacific Northwest. While these data indicate there is little or no local crab fleet in St. Paul, there has, however, been recent local investment in crab harvesters through the local CDQ group.

The level of harvesting, and processing, of crab in the Pribilofs and more specifically around St. Paul has depended on resource population levels and quotas that have fluctuated substantially in recent years. Floating processors and catcher processors processed most of this crab though the 1980s and continue to process much of it. Since 1992, however, shoreplant operations on St. Paul have grown in local importance.

Although community-specific data cannot be parsed out for this region, it is clearly understood through common knowledge that most of the processing within the Rorth region takes place in St. Paul. The processing history for opilio crab for both the North Region and in all regions combined in terms of value for 1991-2000 is shown below.

Value of Opilio and Other Relevant BSAI Crab Species Processing for the North Region and the Total of All Regions, 1991-2000

	North Region (Only)			All Regions (North and South Regions Combined)			North Region as a Percentage of All Regions	
Year	**Opilio**	**All 9 PMA**	**Opilio as % of All PMA**	**Opilio**	**All 9 PMA**	**Opilio as % of All PMA**	**Opilio**	**All 9 PMA**
1991	$15,609,665	$18,743,343	83.3%	$164,468,126	$305,695,929	53.8%	9.5%	6.1%
1992	*	$20,352,531	*	$160,094,620	$289,853,730	55.2%	*	7.0%
1993	$33,704,633	$44,026,160	76.6%	$173,026,231	$304,538,220	56.8%	19.5%	14.5%
1994	$87,386,307	$103,447,046	84.5%	$195,666,718	$283,488,574	69.0%	44.7%	36.5%
1995	$68,943,547	$76,978,258	89.6%	$172,167,486	$221,109,681	77.9%	40.0%	34.8%
1996	$39,783,850	$47,132,139	84.4%	$88,140,168	$154,074,142	57.2%	45.1%	30.6%
1997	$30,663,070	$41,570,835	73.8%	$92,337,590	$147,820,510	62.5%	33.2%	28.1%
1998	$57,357,499	$63,680,397	90.1%	$135,847,412	$191,024,760	71.1%	42.2%	33.3%
1999	$88,524,132	$89,771,698	98.6%	$179,572,974	$264,003,323	68.0%	49.3%	34.0%
2000	$10,125,943	$10,125,943	100.0%	$55,826,325	$111,690,223	50.0%	18.1%	9.1%
1991-2000	$445,046,366	$515,828,351	86.3%	$1,417,147,650	$2,273,299,091	62.3%	31.4%	22.7%
1995-1999	$285,272,097	$319,133,327	89.4%	$668,065,630	$978,032,416	68.3%	42.7%	32.6%

Notes: Cells marked by "*" are confidential.
Numbers for individual relevant BSAI crab species other than opilio and groupings other "all 9 combined" are confidential.
PMA indicates the fisheries included in the crab rationalization management alternatives
Source: Summarized from the NPFMC Bering Sea Crab Data Base / 2001_1

St. George:

St. George is located on the northeast shore of St. George Island, the southern most of five islands in the Pribilofs. It lies 47 miles south of St. Paul Island, 750 air miles west of Anchorage and 250 miles northwest of Unalaska. St. George, located in the Aleutians West Census Area, is not part of an organized borough. The city of St. George, incorporated as a Second Class City in 1983, encompasses 34.8 square miles of land and 147.6 square miles of water.

As was the case on St. Paul, the federally controlled fur seal industry dominated the economy of St. George through most of the 20th century, although commercial sealing ceased on St. George several years earlier than on St. Paul. The presence of large seal populations still contributes to the local economy, as the rookeries and the more than 210 species of nesting sea birds found on St. George's cliffs do support a modest amount of tourism, but local government and fisheries dominate contemporary local employment. The recently restored seal processing facility in the community may be developed as a interpretative and cultural center in conjunction with the USFWS, which manages Alaska Maritime NWR lands and other federally managed resources near the community. There is reportedly no local tourism related to sportfishing at present, although reindeer hunting does draw at least a few hunters from outside of the community, and some individuals temporarily in the community for work projects do at least occasionally take advantage of the opportunity to hunt while in St. George.

St. George has a workforce estimated at 82 residents, and there are approximately 45 full-time equivalent jobs in the community (APICDA 2002), with the largest block of jobs associated with the municipal government. Eleven residents hold commercial fishing permits for halibut. In the not too distant past, the St. George Aquaculture Association explored salmon and shellfish programs but is reportedly inactive at present (2002). Puffin Seafoods opened a small halibut freezing facility in the summer of 1998, and floating crab processors have operated seasonally in the harbor area since the local arrival of the Galaxy (operated by Dutch Harbor Seafoods, an affiliate of UniSea) in the 1980s, but both local halibut and crab processing have not taken place in the past 2 years.

Subsistence still plays a significant role in the household economies within the community. St. George residents may harvest up to 300 fur seals each year for subsistence use, but according to local USFWS personnel, in the last few years annual takes have been variable, with a high year being about 250 animals and a low year being about half that amount. Halibut, reindeer, marine invertebrates, plants, and berries are also subsistence resources that contribute to the local diet. According to local fishermen, subsistence halibut fishing has become more difficult in recent years than in the past, with some of it taking place 10 miles or more at sea, distances unheard of only a few years ago. There is speculation that the trawling that is permitted close to the community (unlike the situation at St. Paul) may be having a detrimental impact on the local subsistence fishery. Locals also report concern over an apparent decline in local fur seal and sea lion abundance.

According to APICDA estimates, there are approximately 28 local fishermen and about 12 local vessels in St. George, with the vessels ranging from 16 to 30 feet in length (APICDA 2002). The community receives a separate allocation of Area 4C halibut, with St. George in the past having gotten 10 percent and St. Paul 90 percent of the total. An increase in the St. George allocation of 15 percent has been proposed, but action has not been taken on the proposal at the time of this writing. Another recent development has been the move of a dedicated 35-foot APICDA-owned vessel from Atka to St. George to tender halibut from St. George to St. Paul.

The primary fishery pursued from local vessels has been halibut utilizing longline gear, although use of jig gear was more common earlier in the development of the local fishery, and jig gear is still in use but more typically on the smaller vessels in the fleet. There is no local commercial cod fishery as tendering cod is not economically viable, and with the exit of crab processing from the community, the potential for the development of a local market of cod for hanging bait has disappeared. The local window for halibut fishing is reported to be 2 months at most, with difficult weather conditions further reducing opportunities.

There are no local crab vessels owned by residents of St. George, although APICDA, of which St. George is a part, does own interests in crab catcher vessels. As there is no local crab processor, there is also no regular delivery fleet. In the relatively recent past, floaters such as Blue Wave and SnoPac have processed crab seasonally while moored in St. George harbor (see below), and these entities had their own associated delivery fleet from outside of the community.

When crab stocks (and quota) were large, smaller floaters processed in St. George harbor (larger floaters were precluded by the size of the harbor), but with depressed crab stocks such operations have reportedly not been economically viable. For the period 1991-2000, typically one such floater operated in St. George (with two present in 1995). Additional floaters may have operated near St. George but do not have a processing location specified in the available database. In recent years, St. George has seen no local crab processing.

Other ports processing BSAI crab:

Dutch Harbor/Unalaska -Dutch Harbor/Unalaska has been called "... the most prosperous stretch of coastline in Alaska." With 27 miles of ports and harbors and several hundred local businesses, most of them servicing, supporting, or relying on the seafood industry, this city is the heart of the Bering Sea fisheries. Dutch Harbor is not only the top ranked fishing port in terms of the tonnage of fish landed in Alaska, but has held that distinction for the Nation, as a whole, each year since 1989, and ranked at or near the top in terms of value of fish landed over the same period.

Historically, Dutch Harbor was principally dependent upon non-groundfish (primarily king and Tanner crab) landings and processing for the bulk of its economic activity. These non-groundfish species continue to be important components of a diverse processing complex in Dutch Harbor. Since the mid-1980s, groundfish and particularly pollock has accounted for the vast majority of landings in Dutch Harbor/Unalaska.

The facilities and related infrastructure in Dutch Harbor/Unalaska support fishing operations in the eastern Bering Sea, Aleutian Islands and GOA management areas. At least eight shore-based processors in this port receive and process fish caught in all three areas, and the wider community is linked to, and substantially dependent upon, serving both the inshore and at-sea sectors of the fishing industry. While Dutch Harbor has been characterized as one of the world's best natural harbors, it offers few alternative opportunities for economic activity beyond fisheries and fisheries support. Its remote location, limited and specialized infrastructure and transportation facilities, and high cost make attracting non-fishery related industrial and/or commercial investment doubtful, at least in the short-run.

Kodiak -Kodiak supports at least nine processing operations which receive groundfish from the GOA and, to a lesser extent, the BSAI, and four more which process exclusively non-groundfish species. The port also supports several hundred commercial fishing vessels, ranging in size from small skiffs to large catcher/processors and everything in between. According to data supplied by the City, "The Port of Kodiak is ‘home port' to 770 commercial fishing vessels. Not only is Kodiak the state's largest fishing port, it is also home to some of Alaska's largest trawl, longline, and crab vessels."

Kodiak has a diversified seafood processing sector. The port historically was very active in the crab fisheries and, although these fisheries have declined from their peaks in the late-1970s and early-1980s, Kodiak continues to support shellfish fisheries, as well as significant harvesting and processing operations for groundfish (particularly flatfish and pollock) Pacific halibut, herring, sablefish, and the five Pacific salmon species.

Environmental Consequences of the Alternatives

4.0 Environmental and Economic Effects of the Alternatives

This section analyzes the environmental consequences of the proposed alternatives on the human environment. Here the human environment refers to the physical, biological and socio-economic environment as described in chapter 3. This section is organized by effects on the blue king crab stock rebuilding (4.1), effects on groundfish stocks and other fisheries (4.2), effects on prohibited species (4.3), effects on EFH (4.4), effects on the ecosystem (4.5) and effects on the socio-economic environment (4.6).

4.1 Effects of the Alternatives on Blue King Crab Stock Rebuilding

This section describes the effects of the alternative harvest strategies (as described in section 2.3) on the blue king crab stock. The first two sections, 4.1.1 and 4.1.2 describe the methodology employed in modeling these harvest strategies. Results of the modeling and the importance to the stock with respect to rebuilding time periods, loss of fishing opportunity and mean yield are presented in 4.1.3.

4.1.1 Stock–recruitment Relationships

In this study, we used the results from the catch-survey analysis (Vining and Zheng 2003) to develop stock recruitment (SR) relationships for Pribilof Islands blue king crabs. Recruitment was assumed to occur within 105-119-mm CL to the male model and within 100-109-mm CL to the female model. A time lag of 8 years was assumed from mating to recruitment. Spawning biomass was estimated as the sum of total biomass of mature females ($\geq$100-mm CL) and mature males ($\geq$120-mm CL).

The association between recruitment and spawning biomass for Pribilof Islands blue king crabs was very weak, and spawning biomass explained very little recruitment variation (Figure 11). The S–R analyses indicate an existence of a quasi-cyclic annual recruitment pattern (Figure 11), with periods with strong and weak recruitment alternating every few years, which caused cyclic spawning biomass over time.

Because of very weak density-dependent effects on recruitment, we modeled the recruitment dynamics with two approaches: (1) random sampling from recruitment estimates from 1978 to 2002 and (2) periodically semi-cyclic with three components (Figure 11): (I) an S–R curve with a flat line for spawning biomass $\geq$5 million pounds and linearly decreasing to zero when spawning biomass is between 5 and 0 million pounds, (ii) random alternation of high and low recruitment patterns (4-9 years of high and 4-9 years of low) estimated from the recruitment residuals, and (iii) log-normal noises. For a given year, the recruitment will be equal to the product of these three components.

4.1.2 Computer Simulations

The four-stage model and S–R relationships were combined in a computer simulation model to estimate rebuilding time periods and rebuilding probabilities for Pribilof Islands blue king crabs under the alternative harvest strategies and, for comparative purposes, under a total closure of the directed fishery (i.e., F = 0). Similar to the "rebuilt" definition for eastern Bering Sea Tanner crabs (*Chionoecetes bairdi*) and St. Matthew Island blue king crabs (*Paralithodes platypus*), we define the stock to be "rebuilt" when mature biomass achieves a level (B_{msy}) capable of producing maximum sustainable yield in two consecutive years. This "rebuilt" definition reduces chances of rebuilding caused by survey measurement errors or a single strong year class. Model parameters for simulations are estimated in the assessment model and summarized in Table 8.

The primary features of the simulation scenarios are as follows:

1. The model was initialized with data on population status for 2002.
2. Because of poor data for small crabs, only males ≥105-mm CL and females ≥100-mm CL were modeled. The mature crabs are defined as males ≥120-mm CL and females ≥100-mm CL. The current B_{msy} (13.2 million pounds, NPFMC 1998) is defined for all male and female blue king crabs based on survey catchability and maturity. Based on the model results from 1983 to 1997, the equivalent B_{msy} was approximated for mature males ≥120-mm CL and mature females ≥100-mm CL as 10.88 million pounds, and the equivalent MSST was approximated as 5.44 million pounds.
3. For each scenario, we simulated the population and fishery for 35 years with 1000 replicates. The average population status, rebuilding probability (the proportion of replicates at rebuilt status), loss of fishing opportunity (the proportion of replicates with fishery closure), and mean yield from the simulations were summarized to compare the Alternatives.
4. Recruitment was modeled with two approaches: (1) random sampling from recruitment estimates from 1978 to 2002 and (2) a cyclic S–R relationship. We used approach (2) as the base model and approach (1) for sensitivity studies.
5. Handling mortality rate of captured, but discarded sublegal males was assumed to be 20% for the directed crab fishery. Sensitivity to assumed handling mortality rate was examined by assuming alternative 0% and 50% handling mortality rates.
6. Because few Pribilof Islands blue king crabs were caught as bycatch from groundfish fisheries, no bycatch mortality from groundfish fisheries was included in the simulations.
7. An assessment error with a standard deviation of 0.3 was assumed. Assessment errors were applied to the abundance in the initial year and the abundance used to compute GHLs.

4.1.3 Results and Discussion

Simulated results are illustrated in Figure 12 and summarized in Table 9. With the base model, the rebuilding time periods at 50% probability are 9 years without a fishery before rebuilding (T_{min}) and 9 and 10 years with the other Alternatives. The rebuilding time periods at 90% probability range from 11 to 25 years. Because T_{min} is less than 10 years, the maximum rebuilding time period, T_{max}, should be 10 years (Restrepo et al. 1998). Due to the low population abundance, the fishery might be closed about 50% or more of the time within a 35-year horizon. Alternatives 1A and 2A have highest mean yield among all 8 Alternatives, but also have highest probability of below MSST and they require longest times to rebuild the stock. By comparison, Alternatives 1B, 2B, 2C, and 2D have shorter rebuilding times while producing relatively high mean yields. Hence, under the base model scenario, Alternatives 1B, 2B, 2C, and 2D are strong candidates for the proposed rebuilding strategy. Alternative 3B also has a short rebuilding time and low probability of below MSST, but also shows some reduction in yield relative to Alternatives 1B, 2B, 2C, and 2D.

Rebuilding time periods and probabilities also depend on assumptions on future recruitment and handling mortality rate (Table 9). At 10% rebuilding probability, rebuilding time periods are longer for Alternatives with a cyclic S–R relationship than Alternatives with random recruitment because the stock was in a period of declining recruitment (Figure 11) and the cyclic recruitment continues that trend. For high rebuilding probabilities (90%), rebuilding time periods are much shorter for Alternatives with a cyclic S–R model than Alternatives with random recruitment because the cycle deterministically turns to high recruitment after a certain number of years. Probabilities of below MSST are much lower for Alternatives with random recruitment than Alternatives with a cyclic S–R model.

Under the base model, rebuilding times and proportions of the next 10 years with the stock below MSST under Alternatives 1B, 2B, 2C, 2D, and 3B are comparable to those under a total fishery closure (F = 0.0). However, in the long term (more than 20 years), the proportion of years below MSST can be expected to be higher under any alternative harvest strategy than when the directed fishery is completely closed. Under the base model, long-term proportion of years below MSST under Alternatives 1B, 2B, 2C, 2D, and 3B are close to that of a total fishery closure when the handling mortality is assumed to be 0.2 or less. Under the random recruitment model, however, only Alternatives 1B and 3B show rebuilding times and proportion of years below MSST comparable to those of a total fishery closure.

Handling mortality rate for blue king crab bycatch from the directed fishery is not very well known. In our study of the red king crab (*Paralithodes camtschaticus*) fishery in Bristol Bay, increased handling mortality in our model resulted in lower optimal harvest rates and higher optimal threshold levels (Zheng et al. 1997). For the Bristol Bay Tanner crab fishery, we found that handling mortality had similar, but less pronounced, effects because of low catchability for females (Zheng and Kruse 1999). Based on limited observer data, catchability of sublegal male and female crabs from the directed blue king crab fishery off Pribilof Islands is similar to or slightly higher than that of Bristol Bay red king crabs. In this study, we considered two extreme handling mortality rates of 0 and 50% in our sensitivity analysis. Overall, higher handling mortality rates increase rebuilding time periods and decrease mean yield, but it appears that a handling mortality rate within our examined range does not greatly impact rebuilding time periods under the likely proposed rebuilding strategies.

Overall, under our base model, T_{min} is 9 years, and T_{max} is 10 years. The target rebuilding time periods (T_{target}) with the likely proposed rebuilding strategies are either 9 or 10 years, within these T_{min} and T_{max} bounds as required by the Magnuson-Stevens Fishery Conservation and Management Act.

To summarize the comparison between the alternatives, the various alternatives are compared with the resulting impact upon rebuilding times, proportion of years below MSST, mean yields and loss of fishing opportunity. In comparing alternative strategies examined which have some directed harvest prior to the stock being rebuilt(Alternative 2), 2B, 2C and 2D have the highest mean yields and the shortest rebuilding times. The primary differences between these options under alternative 2 are in the mean proportion of years with the fishery closed, the proportionate years the stock falls below MSST and the mean yields on the time horizon between 10-35 years. Of these three options, 2B has the lowest proportion of years with fishery closures but also the lowest mean yield. However, it seems to be a viable option for a conservative alternative which also allows for some directed fishing. For alternatives examined that do not allow for a directed fishery until the stock rebuilds to B_{MSY}, 3A has a much higher mean annual yield than 3B (approximately double); however, the period to rebuild with 90% probability under 3A is 20 years as compared to 11 years under 3B. For an alternative with no directed harvest, 3B has a more conservative harvest strategy than 3A, with a lower harvest rate and conservative measure of opening in the second year that the stock exceeds the designated threshold (see section 2.3.3). Model results indicate that both 3A and 3B are similar in the proportion of fishery closures and years below MSST.

4.2 Effects of the alternatives on groundfish stock and fisheries

The groundfish stock and fisheries in the vicinity of the Pribilof District have been listed in Section 3.2.3. The Pribilof blue king crab fishery has the potential to impact the groundfish stock and other fisheries by direct bycatch of these species in the king crab fishery, as well as by the predator/prey interaction of removing blue king crabs from the system and potentially impacting the prey base for predators. Given that the predators of blue king crab (such as Pollock, Pacific herring, sockeye salmon, and yellowfin sole) prey upon the larvae, juvenile stages and soft-shell females, the commercial fishery is not in direct competition with the natural predators of blue king crab. Therefore none of the alternatives proposed would have an impact on the natural predators of blue king crab. A further discussion of the impact of the rebuilding strategies on the ecosystem and the relative trophic interactions will be discussed in section 4.5.

The Pribilof Islands area provides habitat for commercially important groundfish species, blue king crab, juvenile groundfish, Korean hair crab, marine mammals, seabirds and their prey species. The Pribilof Islands Habitat Conservation area, as discussed in section 2.2.3.1 closed a large section of the Pribilof District to all trawling. There is minimal interaction between the groundfish fisheries and the Pribilof Island blue king crab fishery as evidenced by the low bycatch rates of blue king crab in the groundfish fisheries. Given the minimal existing overlap between the groundfish fisheries and blue king crab populations, and low bycatch rates in the groundfish fisheries, bycatch from these fisheries was not included in the alternative analysis. None of the alternatives propose any potential increase in the interaction between these fisheries. None of the alternatives under consideration propose any changes to this no-trawl zone, nor any additional habitat or gear closures to protect blue king crab stocks. Thus there is no additional impact from the rebuilding plans on groundfish stocks due to closures or spatial concentration of the fishery.

All of the alternatives in the rebuilding plan reduce the harvest rate from the status quo (Alternative 1A) and provide for decreased harvest if the stock is below the minimum stock size threshold in those alternative for which there is directed harvest during the rebuilding (Alternatives 2A, 2B, 2C, 2D) and provide for no fishing when the stock is at very low levels of abundance (3A, 3B). Alternative 1B, 2B, 2C and 3B provide for additional conservative management by allowing for no directed harvest until the second year that the stock is above the specified threshold for that alternative. The action proposed by this FMP amendment will not increase the amount of harvest, the intensity of harvest, or the location of harvest, therefore, this action is presumed to have an insignificant effect on groundfish stocks and other fisheries.

4.3 Effects of the Alternatives on ESA Protected Species

The protected species in the BSAI crab management area have been described under section 3.2.4 of this document. Consultative actions taken by the responsible agency (NMFS or USFWS depending upon the species) have been described in these sections.

4.3.1 ESA-listed Marine Mammals

Based upon previous consultations (see section 3.2.4.1) NMFS Sustainable Fisheries has concluded that the actions considered in the Biological Assessment reviewing the crab fisheries prosecuted under the FMP are not likely to (1) result in the direct take or compete for the prey of the seven large protected whale species or the western and eastern population of Steller sea lions, or (2) destroy or adversely modify designated Steller sea lion critical habitat. NMFS protected resources concurred with this determination, and concluded a formal consultation is not required (NMFS 2001b). The action proposed by this FMP amendment is presumed not to increase the impacts of the fishery on endangered or threatened marine mammals or critical habitat in this action area. Therefore, this action is not likely to adversely effect listed marine mammals or destroy or modify designated critical habitat.

4.3.2 ESA-listed Seabirds

From the Biological Assessments prepared by NMFS for the king and Tanner crab FMP, NMFS determined that the crab fisheries do not adversely affect listed species or destroy or modify their critical habitat (NMFS 2002). For seabirds, USFWS concurred with NMFS' determination, and concluded a formal consultation is not required (USFWS 2003). The action proposed by this FMP amendment is presumed not to increase the impacts of the fishery on seabirds in this action area. Therefore, this action is not likely to adversely effect listed seabirds or destroy or modify designated critical habitat.

4.4 Effects of the Alternatives on Habitat and Essential Fish Habitat Assessment

This addresses the mandatory requirements for an EFH assessment enumerated in the Final Rule (67 FR 2343, January 17, 2002) implementing the EFH provisions of the Magnuson-Stevens Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267). An EFH assessment is prepared for any federal action that may adversely affect EFH. These requirements are:

- a description of the action (see section 2.3 of this EA);
- an analysis of the potential adverse effects of the action on EFH and the managed species;
- the federal agency's conclusions regarding the effects of the action on EFH; and
- proposed mitigation, if applicable.

An EFH assessment may incorporate by reference other relevant environmental assessment documents, such as a BA, another NEPA document, or an EFH assessment prepared for a similar action.

EFH is defined in the Magnuson-Stevens Act as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." (16 U.S.C. 1802 Sec. 3, 104-297). The Final Rule defines adverse effect as any impact that reduces quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

The area affected by the proposed action has been identified as EFH for all of the FMP managed species in the BSAI. EFH for these species is described and identified in four FMP amendments which were approved January 20, 1999. These are: Amendment 55 to the FMP for the Groundfish Fishery of the Bering Sea and Aleutian Islands Area; Amendment 8 to the FMP for Bering Sea and Aleutian Islands King and Tanner Crabs.

This analysis focuses on the effects of fishing under the alternative rebuilding plans on benthic habitat important to commercial fish species and their prey. According to the EA for Amendment 8 to Crab FMP, it is reasonable to assume that the blue king crab fishery may impact the EFH of the following species: yellowfin sole, rock sole, flathead sole, skates, sculpins, golden king crab, scarlet king crab, C. opilio crab, and triangle Tanner crab. Insufficient data exists to determine the extent of the impacts on EFH, beyond the fact that the blue king crab fishery occurs in the species general distribution. No evidence suggests that the blue king crab fishery impacts the EFH of salmon or scallops.

Two issues of concern with respect to EFH effects are the potential for damage or removal of fragile biota that are used by fish as habitat, the potential reduction of habitat complexity, which depends on the structural components of the living and nonliving substrate; and potential reduction in benthic diversity from longlasting changes to the species mix.

Each alternative is rated as to whether it may have significant effects in three ways:
1. Removal of or damage to Habitat Areas of Particular Concern (HAPC) biota by fishing gear
2. Modification of nonliving substrate, and/or damage to small epifauna and infauna by fishing gear
3. Change in benthic biodiversity

The blue king crab fishery does not occur in any areas designated as Habitat Areas of Particular Concern (HAPC). Therefore none of the alternative would result in removal or damage to HAPC by fishing gear in this fishery. Pot gear is not known to modify nonliving substrate. Pot gear does cause some damage to small epifauna and infauna in the setting and retrieval of the pots, but existing information indicates that these effects are minimal and temporary (NMFS 2003). All of the alternatives would reduce fishing for blue king crab near the Pribilof Islands, thereby reducing any potential impacts of this fishery on small epifauna and infauna. No evidence indicates that the blue king crab fisheries in the Pribilof Islands cause a change in benthic biodiversity, and the actions under consideration further reduce any potential effects of the fishery on benthic biodiversity. Therefore, NMFS concludes that the rebuilding plans would have an insignificant effect on EFH for managed species managed under the four North Pacific FMPs. Additionally, given that mitigation measures to minimize effects on EFH have been undertaken through ongoing fishery management measures whose principal goal was to protect and rebuild crab stocks, but whose results have also resulted in a benefit to habitat for all managed species, any potential significant adverse effects by this Federal action have been minimized to the extent practicable. None of the rebuilding plans that would be specified under these alternatives would have impacts beyond those displayed in previous analyses of the effects of the Pribilof Islands blue king crab fisheries on marine benthic habitat, therefore, findings of insignificant are made for the Pribilof Islands blue king crab rebuilding plan. As a result of this determination, an EFH consultation is not required.

Given the current status of Pribilof Islands blue king crab, it seems reasonable that the importance of blue king crab EFH in maintaining stock productivity should be a priority message contained in consultations on any proposed activities in this region. To the extent feasible and practicable, this area should be protected from adverse impacts. The final rule for EFH states the following in the case of an overfished stock: "If a species is overfished, and habitat loss or degradation may be contributing to the species being identified as overfished, all habitats currently used by the species may be considered essential in addition to certain historic habitats that are necessary to support rebuilding the fishery and for which restoration is technologically and economically feasible. Once the fishery is no longer considered overfished, the EFH identification should be reviewed and amended, if appropriate."

As described in section 2.2.3.1, the Pribilof Islands Habitat Conservation Zone was implemented in 1995 to protect the habitat and ecosystem surrounding the Pribilofs. The conservation area was specifically designed to protect the majority of the crab habitat in this region (NPFMC 1994). A recent analysis of NMFS EBS trawl survey data from 1995 through 2002 indicates that, annually, 84% to 98% of the total surveyed Pribilof blue king crab population is inside the PIHCA (I. Vining, personal communication, ADF&G, Kodiak). No additional habitat closures for blue king crab are proposed in this analysis given that this existing closure already protects the majority of blue king crab habitat.

4.5 Effects of the Alternatives on the Ecosystem

Removals of blue king crab by the commercial fishery removes predators, prey, or competitors and thus could conceivably alter predator-prey relationships relative to an unfished system. Studies from other ecosystems have been conducted to determine whether predators were controlling prey populations and whether fishing down predators produced a corresponding increase in prey. Similarly, the examination of fishing effects on prey populations has been conducted to evaluate impacts on predators. Finally, fishing down of competitors has the potential to produce species replacements in trophic guilds (Hall 1999). Evidence from other ecosystems presents mixed results about the possible importance of fishing in causing population changes of the fished species' prey, predators, or competitors. Some studies showed a relationship, while others showed that the changes were more likely due to direct environmental influences on the prey, predator, or competitor species rather than a food web effect. Fishing does have the potential to impact food webs but each ecosystem must be examined to determine how important it is for that ecosystem.

Little research has been conducted on the trophic interactions of Pribilof blue king crab. Known predators of blue king crab in the eastern Bering Sea were listed in Section 3.2.3.1: Pacific cod as predators on juveniles and adults and walleye pollock and yellowfin sole as predators on larvae and early-stage juveniles. We assume, however, that the predators known to feed on red king crab at various life stages are also important predators of blue king crab in the Pribilofs. Pribilof blue king crab larvae are present in the water column from April to August (Armstrong et al. 1987) and fish species known to feed on red king crab larvae (including walleye pollock, Pacific herring, sockeye salmon, and yellowfin sole) would be expected to also feed on blue king crab larvae. After settlement in August and early September (Armstrong et al. 1987) juvenile blue king crab would be expected to fall prey to the same predators on juvenile red king crab; e.g., most flatfish species, halibut, sablefish, skates, sculpins, sea stars, and larger juvenile instars of the same species. Larger adult blue king crab would also be expected to serve as prey when in soft-shell condition following a molt; e.g., Pacific cod have been documented as consuming soft-shell adult female blue king crabs.

Taxa that have been documented as prey of blue king crabs were listed in Section 3.2.3.1: polychaetes, echinoderms, and molluscs. We also assume that blue king crab prey upon the same species described by Feder and Jewett (1981) as important prey for red king crab in the Bering Sea: bivalve mollusks, snails, sea urchins, sea stars, sand dollars, polychaete worms, and crustaceans, including other crabs.

The competitive relationship of blue king crab with other species has not been studied, although the similarities in morphology and differences in the distribution of red and blue king crab suggest that the red king crab is a competitor of the blue king crab (Somerton 1985). From the 1970s through 1988, blue king crabs were numerically dominant over red king crabs in the Pribilof District. Estimates of mature biomass for red king crab and blue king crab in the Pribilof District were roughly equivalent during 1989-2000, with some variation about a 1:1 ratio due to estimation error. The 2001 and 2002 NMFS EBS surveys indicate that mature biomass of red king crab is now dominant over blue king crab in the Pribilof District. However, it is not clear whether that trend reflects competition between red and blue king crab, the opportunity for red king crabs to replace blue king crabs following declines in the blue king crab stock, or inverse responses of the two congeners to the same environmental factor. In addition to the possible competition between red and blue king crabs, king crabs may also be in competition, at least seasonally, with the flat fish that feed on a similar diet of benthic invertebrates (Feder and Jewett 1981).

Effects of alternatives to predators of blue king crab could be considered at two levels: 1) directly reducing a food source for predators through fishery removals; and 2) long-term reduction of the food source for predators by lowering long term stock productivity. From what is known of the predators of blue king crab, the commercial fishery is not in direct competition with the natural predators of blue king crab. The fishery removes large mature males in hardshell condition, whereas predators prey upon larvae, juvenile stages, and mature females in soft-shell condition. Hence, it is unlikely that the commercial fishery removals have any direct effect on the prey base of blue king crab predators and all rebuilding plan alternatives are equivalent in this regard.

Long-term negative effects to the prey base for predators by reduced reproduction resulting from fishery removals of mature males also seems unlikely under all alternatives considered. No reliance of the identified predators on production of blue king crab larvae and juveniles has been established; in fact, the flatfish and gadids identified as predators have maintained high stock abundance levels during the period that Pribilof blue king crab have been at low and declining levels. Moreover, the historic pattern of recruitment of the blue king crab stock and the relationship between spawning biomass and recruitment indicate that environmental factors are a greater determinant of variablity in reproductive success than effects due to removals of mature males at the rates considered by any of the alternatives.

With trophic interactions and interspecific competition so poorly understood, it is not possible to clearly specify the effects to the ecosystem of alternative rebuilding plans. However, given the nature of the action, the presumed effects of the alternatives on the ecosystem are insignificant.

4.6 Socio-economic effects of the Alternatives

This section provides information about the economic and socioeconomic impacts of the alternatives including identification of the individuals or groups that may be affected by the action, the nature of these impacts, quantification of the economic impacts if possible, and discussion of the potential impact of crab rationalization on these communities. More information on the impact of alternative crab rationalization strategies on these communities will be available in the EIS for the crab FMP produced by the agency in the coming year. The objective of this amendment is specifically to rebuild the Pribilof Islands blue king crab stock to sustainable levels thus the focus of this analysis is on relative impacts of the rebuilding plans on the regional communities.

The rebuilding plan does not contain implementing regulations so a regulatory impact review under E.O. 12866 and initial regulatory flexibility analysis under the Regulatory Flexibility Act are not required.

National Standard 8 of the Magnuson-Stevens Act mandates that conservation and management shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to provide for the sustained participation of such communities, and to the extent practicable, minimize adverse economic impacts on such communities.

Many of the coastal communities participate in the crab and groundfish fisheries is one way or another, whether it be processing, support businesses, have a harbor, or are home to fishermen and processing workers. Major groundfish and crab ports in Alaska that process catch from the Bering Sea include Dutch Harbor, St. Paul, Akutan, Sand Point, King Cove, and Kodiak. Additionally, Seattle, Washington is home port to many catcher and catcher-processor vessels. The communities most impacted by the closure of the Pribilof Islands blue king crab fishery are the two communities discussed in-depth in section 3.3; St. Paul and St. George. Quantitative processing information is not well developed for the North region (made up primarily of St. Paul), and confidentiality restrictions prohibit disclosure of what information is known.

However it is well understood that BSAI crab species (especially snow crab, *C. opilio*) and halibut are the two most important fisheries in this region. The crab species processed fund a large percentage of the regional community tax base through raw fish taxes, and the halibut fishery engages many of the local fishermen.

Vessel participation in the fishery has varied over the years. Currently, participation is limited by the License Limitation Program (LLP) for this fishery. Under this program, maximum of 136 vessels may participate in this fishery. Before the fishery closed in 1999, an average of 81 vessels participated in the fishery over the most recent five year period (1994-1999).

The Pribilof Islands crab fishery has developed concurrently with the St. Matthew Island crab fishery and both regions have had similar problems with declining (and eventually overfished) blue king crab stocks. The following is excerpted from Kruse et al.(2000), describing the historical participation in the blue king crab fishery, both St. Matthew and Pribilof Islands.

> "In 1965 the Japanese developed a blue king crab fishery in the Pribilof District. The U.S. fleet first participated in this fishery in 1973, when they fished in the vicinity of St. George and St. Paul Islands. In the 1970s blue king crab were primarily taken as bycatch in the snow and Tanner crab fisheries. The catch peaked in 1980/81 at 4,976 mt by 110 vessels. The effort peaked at 126 vessels in 1983/84. Thereafter, the catch and effort sharply declines until the fishery was closed in 1988/89 due to low abundance (Figure 13). Some of the landing records in the 1990s were mixed with red king crab catches; therefore, the blue king crab catches were underestimated during this period. A commercially viable blue king crab resource was discovered around St. Matthew Island in the 1970s and U.S. vessels started exploiting this population in 1977 and the harvest peaked at 4,288 mt with an effort of 164 vessels in 1983. The catch declined thereafter, and stabilized at two low levels: during 1986 and 1990 at a low catch range of 455-783 mt with an effort range of 31-69 vessels and during 1991 to 1998 at a slightly higher catch range of 1,122 - 2,109 mt (Figure 13) with 68-174 vessels. Escalation of effort has been checked by concurrently opening St. Matthew and the Pribilof Islands crab fisheries and enforcing pot limits (Morrison et al. 2000; Zheng et al. 1997 as cited in Kruse et al. 2000)."

While specific area designations are confidential, the importance of Pribilof Islands blue king crab as a percentage of the entire BSAI crab processed is available. For the time period 1991-2000, the total pounds of Pribilof Islands blue king crab processed was 3,098,193 pounds. This makes up approximately 0.15% of the total of all crab species processed in all regions for this time period. The average annual value over these years for Pribilof blue king crab was $747,600. This is 0.3% of the total value of all crab processed.

The alternative rebuilding plans give a time period for rebuilding of between 9 (T_{min}) to 10 (T_{max}) years to rebuild the stock within a 50% probability range. The possibility of fishery closures under all of the alternatives within a 35 year time horizon is better than 50%. Alternative 2 (options A and B) allows for some harvest of blue king crabs while the fishery is being rebuilt, although this will have a minimal impact on the communities given the low percent contribution (0.3%) of Pribilof blue king crabs to the total crabs processed.

However, the costs of reduced fishing opportunities during the rebuilding period may be more than offset by benefits gained from eventually rebuilding the stock to its MSY level. Note that ADF&G does not allow directed fisheries for Pribilof Islands blue king crab when the stock is at low abundance (e.g., since1999), so the ex-vessel value is $0. In the 4 years that the fishery was open, from 1995-1998, the fishery generated ex-vessel total values of 1.1 -3.1 million dollars annually (see section 3.3.1). There is some potential for revenue under the alternative 2 scenarios, as there is the possibility of some directed harvest while the stock is being rebuilt. In 1998, the last year of a directed fishery for this stock, the ex-vessel value of the fishery was $1,111,172, with a total landed pounds of 494,424 pounds (see section 3.3.1). This annual value, depending upon stock levels and GHLs, would be available to the fishery again once the stock is rebuilt. A portion of this revenue could also be available during the rebuilding time period under Alternative 2. As stated in section 4.1, alternatives 2B, 2C and 2D have relatively high mean yields following rebuilding and the shortest rebuilding time periods.

The preferred alternative, Alternative 3B, is the most conservative alternative examined, whereby no fishing will be allowed until the stock has completely recovered, and the threshold for opening is such that the fishery is not opened until the second year that the stock is above B_{MSY} (13.2 million pounds). This alternative incorporates a harvest strategy that includes additional conservative measures: a delayed opening to the second year that the stock is above this threshold (13.2 million pounds), a harvest rate on mature males of 10% of the survey estimate, a cap on the harvest of mature males at 20% of the survey estimate, and a minimum GHL of 0.5 million pounds. This rebuilding plan applies to all participants equally, thus it allocates the plan's restrictions fairly and equitably among sectors of the fishery. Once the stock has been rebuilt, the recovery benefits will be allocated fairly and equitably among sectors of the fishery as well.

A conservative rebuilding plan is warranted at this time for this stock given the concerns regarding the rebuilding potential of this stock, the potential vulnerability to overfishing, the poor precision of survey estimates, and the limited information available on bycatch of blue king crab in a directed red king crab fishery. The other alternatives under consideration would not provide sufficient safeguards for this vulnerable stock. The preferred alternative, while forgoing harvest in the short-term, is the strongest guarantee that the stock will be healthy and support a fishery in the long term. Once rebuilt, these coastal communities would once again have expanded opportunities (both fishing and processing) in this potentially lucrative fishery. Therefore, the alternatives would have insignificant socio-economic effects on participants and fishing communities.

Impacts on Safety

Safety is a primary and often-cited concern for captains and crews in the BSAI crab fisheries. The BSAI crab fisheries occur primarily in the winter, when weather conditions can be dangerous. Winds in excess of 60 knots accompanied with heavy seas and freezing rain, sleet, and/or snow are common. The stacking of crab pots on deck, coupled with icing, can greatly reduce a vessel's stability. Additionally, the fisheries suffer from the 'race for fish', causing fishermen to risk safety in order to race to catch more crab faster than the other fishermen. Between 1990 and 2001, 61 fatalities occurred and 25 vessels were lost in the BSAI crab fisheries.

The Pribilof Islands blue king crab fishery is safer that the other crab fisheries because it is prosecuted in the fall and closer to land. No fatalities are known to have occurred in this fishery. The alternatives considered would decrease safety concerns in the short term because the fishery will be closed. However, in the long term, safety under the alternative rebuilding plans would be similar to status quo. The alternatives will have an insignificant effect on safety.

Potential Impacts of Crab Rationalization

None of the alternative rebuilding plans proposed would have an impact on the rationalization alternatives for the BSAI crab fisheries currently under consideration by the Council. The rebuilding plans would be in effect prior to rationalization of the fishery, and under Magnuson-Stevens Act the stock would remain under the rebuilding plan until the stock was rebuilt. The Pribilof Island blue king crab fishery is included in the proposed BSAI crab rationalization plans described in the forthcoming crab EIS. These rationalization plans could impact the blue king crab fishery. The three alternative rationalization schemes proposed may confer environmental benefits on the crab fisheries.

All three of the rationalization alternatives are likely to contribute environmental benefits from both improved fishing practices and improved management of stocks. Changes in the fisheries under rationalization and their effects on stocks, however, cannot be fully predicted. Increased soak times are anticipated in a rationalized fishery. These increases could lead to improved sorting of harvests by gear reducing the amount and handling of discards in the fishery. A reduction of discards is likely to reduce mortality to the benefit of stocks. If fishers are able to fish with greater care in a rationalized fishery, they also may be able to reduce the number of pots that are lost on the grounds each year.

One consequence of rationalization to the management of the Pribilof blue king crab fishery that must be considered is the change to managing towards preseason harvest quotas, as opposed to current practice of management towards as a preseason harvest guideline level (GHL). Management towards a GHL is more flexible than management towards a strict quota. Under the current management system, management towards a preseason GHL allows the State to make in-season management decisions based on current data obtained from the fishery; if fishery performance is below that expected from preseason estimates, the fishery can be closed before the GHL is attained. Under a quota system, however, that flexibility would be lost. Hence, given the poor precision of preseason abundance estimates for the Pribilof blue king crab stock, preseason fishery quotas under rationalization should be set using a harvest strategy that establishes quotas that are attainable without risking conservation of the stock.

Additional benefits could also arise from other effects of rationalization. Improving the timing of deliveries to processors may reduce queuing times, which can be as high as 36 hours in some of the current fisheries. Reducing the amount of time crab spend in a vessel's tanks should decrease the number of crab that die during the wait to offload. Since crab must be processed live, crab that die in the tank (deadloss) have no market value. If deadloss were to be decreased it would reduce the amount of crab harvested that is not utilized.

In a rationalized fishery, catch is likely to be managed more precisely than in the current competitive fishery. In the competitive fishery, harvests are monitored through voluntary inseason reports from participants. In a rationalized fishery, with no permitted overages or underages, overharvests could be minimized because the catch of each vessel is strictly limited by share holdings. Penalties will be instituted to ensure that the limits are not exceeded.

A competing effect could arise if harvesters perceive a benefit to high grading. High grading is likely to occur if the increase in revenue from discarding low value, barnacled or brown shell crab and harvesting high value, clean shell crab exceeds the increase in cost of making those discards and harvests. To the extent that efforts of the harvest sector to increase quality of catch increase discard mortality, these efforts could reduce the net benefits derived from the fishery in the long run. Harm to stocks from high grading could decrease future harvests and total revenues realized from the fishery. Issuance of fixed harvest allocations that extend several years into the future are argued by some to reduce the incentive for detrimental high grading, if fishers perceive a future cost to high grading. The extent and effects of any high grading problem cannot be predicted. Both harvest strategy modifications and improved monitoring could be used to mitigate the effects of high grading.

Improvements in the precision of management of the crab fisheries should result in an increase in net benefits under rationalization. Although certain incentives in a rationalized fishery could result in environmentally harmful fishing practices, careful monitoring can be used to minimize harmful practices. With a well-tailored monitoring program, rationalization could lead to improved environmental conditions and an increase in the net benefits to the environment.

There is the potential that rationalization of the fishery could have an adverse impact upon the regional economy and the processing sector in St. Paul. Most processors that operate in the Pribilofs also process crab in other locations (with shoreplants and/or floating facilities). Those processors that operate only floaters in the Pribilofs could operate those same facilities anywhere that logic and economic incentives dictate, while the single north region shoreplant (in St. Paul) is fixed in location. Processors indicate that under the current open-access management system, with a race for crab, operating in the Pribilofs makes economic sense. Although the costs of operation in the Pribilofs are stated to be higher, and the logistics involved more complicated, than for Unalaska/Dutch Harbor, Kodiak, or a number of other ports, these factors are offset by proximity to the resource under race-for-fish. This proximity enables harvesters to catch more crab within a shorter period of time. If such time constraints are relaxed, the desirability of operating in the Pribilofs would be reevaluated. In other words, the current inefficiency or overcapitalization in the crab fishery makes the relatively expensive operations in St. Paul worthwhile. If the fishery were to become more efficient through some type of rationalization program, it could be anticipated that at least some processing operations would be consolidated, with a likely result, if operating costs in the Pribilofs are/remain higher than in other locations, of moving processing partially or entirely away from St. Paul. It should be noted that this result can be anticipated even if operating costs in St. Paul are not significantly higher than in other locations or could be reduced by local changes. As stated above, all current St. Paul crab processors also operate facilities in other locations and under a rationalized fishery would have excess processing capacity elsewhere with which St. Paul operations could be consolidated. More information on the potential impacts of crab rationalization on this and other regional communities will be available in the forthcoming EIS for the crab FMP.

4.7 Cumulative Effects

This section discusses those past, present or reasonably foreseeable impacts which may occur as a result of the proposed action and have not yet been discussed in the previous environmental consequences sections. For the Pribilof blue king crab population, the two cumulative impacts, past and forseeable future, are the unexplained population decline as described, and the potential future impacts of crab rationalization.

As has been described in sections 2.2.1, 2.2.2, and 3.2.1, the Pribilof Islands blue king crab stock has been declining and the specific reasons behind this decline are not well understood. One hypothesis behind the decline, as discussed in section 2.2.1, is environmental variability and climate change leading to a possible gradual replacement of blue king crab by red king crab during post glacial times. Possible effects of increased groundfish stock levels since the late 1970s and early 1980s on the Pribilof blue king crab stocks were discussed in section 3.2.3, but cause and effect has not been established as an explanation for the decline. This fishery has only been open for directed harvest for 4 seasons since 1988. Harvest levels during those 4 seasons, as described in section 2.2.2, were even more conservative than the specified state harvest strategy. Critical habitat for this stock has been closed since 1995. Other crab fisheries, such as the Pribilof red king crab, which could contribute to the bycatch of Pribilof blue king crab have been closed since 1999. Yet there has been no recovery in this stock. While directed fishing is not presumed to be causing the current decline, some combination of historical harvest and environmental variability has had an adverse impact on the sustainability of this stock.

The MSST for this stock is currently established at 6.6 million pounds for this stock following amendment 7 to the crab FMP. The overfishing level is defined by a constant fishing mortality MSY-Control Rule equating F_{MSY} to M and “overfished” status by the MSST, equal to half of the MSY stock size. The MSY stock size is the average mature biomass observed over the 15 year period from 1983-1997. The Crab Plan Team has been reexamining the appropriate threshold and targets harvest rate levels and MSST value for all of the FMP managed crab stocks. Preliminary results for the Pribilof blue king crab stock suggest that the appropriate MSST would be 7.08 million pounds (ADF&G draft report 2003). The Crab Plan Team will present a report on reevaluation of the MSSTs for all managed crab stocks at the December, 2003 Council meeting.

Crab rationalization is a reasonably foreseeable future impact on the Pribilof blue king crab fishery. Rationalizing the fishery will likely increase efficiency of catch and impact the stocks as described in section 4.6. The specific impacts of rationalization on the fishery are as yet unclear. More information on the potential impacts of rationalization on all FMP managed crab species will be available in the forthcoming EIS for crab.

4.8 Summary and Conclusions

The Pribilof Islands blue king crab (*Paralithodes platypus*) stock was declared overfished according to the criteria in the BSAI King and Tanner Crab FMP on September 23, 2002. The recent stock assessment showed that the stock was below minimum stock size threshold (MSST) and there were no signs of recovery in the trawl survey data. Pursuant to MSA guidelines, once a stock has been declared overfished, a rebuilding plan must be developed within one year. This EA analyses alternative rebuilding plans for Pribilof Islands red king crab.

Comparison of Alternatives and Selection of a Preferred Alternative

Three alternative rebuilding strategies were examined. These strategies included Alternative 1, the status quo management of this fishery, Alternative 2, a rebuilding plan which allows for some directed harvest prior to the stock being rebuilt and Alternative 3 a rebuilding plan which allows for no directed harvest prior to the stock being rebuilt. Options under each alternative included a range of thresholds for opening the fishery, a range of harvest strategies for the directed fishery, and conservative time periods above the designated threshold for opening the fishery. No additional habitat or bycatch measures were proposed in any of the alternatives. Given the existing Pribilof Islands Habitat Conservation Zone and the fact that the bycatch of blue king crab in both crab and groundfish fisheries is a very low proportion of the total population abundance, neither habitat nor bycatch measures were expected to have a measurable impact in the rebuilding alternatives.

The minimum time period for rebuilding with a 50% probability is 9 years (T_{min}) and the maximum time period is 10 years (T_{max}). Alternatives 1A and 2A provided for the highest possible mean annual yield in a 10, 20 and 35 year time horizon. However, these alternatives also had a much higher proportion of years with the stock below MSST for the same time horizon. Alternatives 1B, 2B, 2C and 2D provide the shortest timeframe for rebuilding with the lowest corresponding proportion of years with the stock below MSST, coupled with a relatively high mean annual yield. These alternatives are all strong candidates for the preferred option. Alternatives 2B, 2C and 2D all provide for some directed harvest prior to the stock being rebuilt which may alleviate some of the financial burden on the affected communities.

The preferred alternative, Alternative 3B, is the most conservative alternative examined, whereby no fishing will be allowed until the stock has completely recovered, and the threshold for opening is such that the fishery is not opened until the second year that the stock is above B_{MSY} (13.2 million pounds). This alternative incorporates a harvest strategy that includes additional conservative measures: a delayed opening to the second year that the stock is above this threshold (13.2 million pounds), a harvest rate on mature males of 10% of the survey estimate, a cap on the harvest of mature males at 20% of the survey estimate, and a minimum GHL of 0.5 million pounds. A conservative rebuilding plan is warranted at this time for this stock given the concerns regarding the rebuilding potential of this stock, the potential vulnerability to overfishing, the poor precision of survey estimates, and the limited bycatch information available. The other alternatives under consideration would not provide sufficient safeguards for this vulnerable stock. The preferred alternative, while forgoing harvest in the short-term, is the strongest guarantee that the stock will be healthy and support a fishery in the long term.

Significance of Impacts

One of the purposes of an EA is to provide the evidence and analysis necessary to decide whether an agency must prepare an environmental impact statement (EIS). This analysis informs the decision maker's determination that the proposed action will or will not result in significant impacts to the human environment. If the action is believed to result in significant impacts, then further analysis in an EIS is required. Council on Environmental Quality regulations define significance in terms of context and intensity (40 CFR 1508.27). An action must be evaluated at different spatial scales and settings to determine the context of the action. Intensity is evaluated with respect to the nature of impacts and the resources or environmental components affected by the action. NOAA Administrative Order 216-6 provides guidance on National Environmental Policy Act (NEPA) specific to line agencies within NOAA. It further specifies the definition of significance in the fishery management context by listing factors that should be used to test the significance of fishery management actions (NAO 216-6 § 6.01 and 6.02). These factors form the basis of the analysis presented in Section 4.0 of the this EA, Environmental and Economic Impacts of the Alternatives. The results of that analysis are summarized here for each factor.

Context: The setting of the proposed action is the crab fisheries of the BSAI, specifically the blue king crab fishery near the Pribilof Islands. Environmental effects of the action are limited to this area. The socio-economic effects of the alternatives within this area are limited to the individuals who participate in the Pribilof Islands blue king crab fishery and the communities that support the fishing fleet and blue king crab processors.

Intensity: Listings of considerations to determine intensity of the impacts are in 50 CFR § 1508.27 (b) and in the NOAA Administrative Order 216-6, Section 6. Each consideration is addressed below and analysis of each consideration is contained in the EA prepared for this action.

1. *Can the proposed action be reasonably expected to jeopardize the sustainability of any target species that may be affected by the action?*

The impacts of the proposed action on the target species, blue king crab, are discussed in section 4 of the EA. The proposed action will not jeopardize the sustainability of any target species that may be affected by this action. The result of the action is the continued closure of the Pribilof Islands blue king crab fishery until the stock is considered rebuilt under the terms of the rebuilding plan. Once rebuilt, the fishery will be prosecuted under a conservative harvest strategy that aims to prevent overfishing and future stock declines below the minimum stock size threshold.

2. *Can the proposed action be reasonably expected to allow substantial damage to the ocean and coastal habitats and/or EFH as defined under the Magnuson-Stevens Act and identified in FMPs?*

Impacts of the proposed action on habitat, including the EFH assessment, are discussed in section 4.4 of this document. . The proposed action will close the fishery during the rebuilding time period, thus removing all impacts of this fishery on habitat, including EFH. Once the fishery reopens, the proposed action will not change the prosecution of the fishery or its impacts on the ocean and coastal habitats and/or EFH as defined under the Magnuson-Stevens Act and identified in the FMP. Thus, the proposed action will have an insignificant effect on ocean and coastal habitats and EFH.

3. *Can the proposed action be reasonably expected to have a substantial adverse impact on public health or safety?*

The proposed action, which will close the fishery until the stock is rebuilt, will not have a substantial adverse or significant impact on safety, as discussed in section 4.6.

4. *Can the proposed action be reasonably expected to have an adverse impact on endangered or threatened species, marine mammals, or critical habitat of these species?*

The proposed action will have insignificant impacts on endangered species, marine mammals, or critical habitat for these species, as discussed in sections 4.3 of the EA.

5. *Can the proposed action be reasonably expected to result in cumulative adverse effects that could have a substantial effect on the target species or non-target species?*

Cumulative effects are discussed in section 4.7 of the EA. This proposed action will not result in cumulative adverse or significant effects that could have a substantial effect on target or non-target species.

6. *Can the proposed action be reasonably expected to jeopardize the sustainability of any non-target species?*

The proposed action is not expected to jeopardize the sustainability of any non-target species and will not have any significant impacts on non-target species, as discussed in section 4.2 of the EA.

7. *Can the proposed action be expected to have a substantial impact on biodiversity and ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)?*

The proposed action will have an insignificant impact on biodiversity and ecosystem function, as discussed in section 4.5 of the EA.

8. *Are significant social or economic impacts interrelated with significant natural or physical environmental effects?*

The analyses for this action concluded that the economic and social effects are insignificant, as discussed in section 4.6 of the EA.

9. *To what degree are the effects on the quality of human environment expected to be highly controversial?*

This action's effects on the quality of the human environment are not controversial and insignificant. Development of the action was a consensus process with the State of Alaska.

10. *Can the proposed action be expected to have a substantial impact on cultural resources and ecologically critical areas?*

This action takes place near the Pribilof Islands, a geographic area of the Bering Sea. The land adjacent to these areas contain cultural resources and ecologically critical areas. The marine waters where the fisheries occur contain ecologically critical area. Effects of this action on the unique characteristics of these areas are insignificant.

11. *Can the proposed action be expected to result in future actions?*

The resulting future action would be the opening of the fishery, once the stock rebuilds, under a conservative harvest strategy, as discussed in section 2.3 of the EA.

12. *Can the proposed action be expected to effect districts, sites, highways, structures, or objects listed or eligible for listing in the National Register of Historic?*

This consideration is not applicable to this action.

13. *Will the proposed action be expected to violate Federal, state, or local law for environmental protection?*

No Federal, state, or local law will be violated with this action.

14. *Can the proposed action be expected to introduce or spread of non-indigenous species?*

This consideration is not applicable to this action.

5.0 List of Preparers

<u>NPFMC</u>: Diana Stram
<u>ADF&G</u>: Douglas Pengilly, Wayne Donaldson, Jie Zheng, Shareef Siddeek, Forrest Bowers, David Barnard, Ivan Vining
<u>NMFS</u>: Gretchen Harrington, Robert Otto, Jay Ginter, Jack Turnock, Claire Armistead, Rich MacIntosh

6.0 Agencies, Organizations and Persons receiving copies of the EA

Copies of this draft for public review were made available to the following:

North Pacific Fishery Management Council
Scientific and Statistical Committee
Advisory Panel
Crab Plan Team

7.0 Literature Cited

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8.0 Tables

Table1: Annual abundance estimates (millions of crabs) for blue king crab in the Pribilof District from NMFS surveys (Stevens et al. 2002).

Table 2: Annual abundance estimates (millions of crabs) and 95% confidence intervals for 2002 of male blue king crabs in the Pribilof District estimated by 4-stage catch-survey analysis from 1975-2002. Size measurements are in mm CL. From Vining and Zheng (2003).

Table 3: Fishery guideline harvest levels (GHLs) and closure decisions for the Pribilofs blue king crab fishery, 1990-2002.

Table 4: Historic Pribilof blue king crab fishery stock abundance indices and harvests, 1990-2002.

Table 5: Comparison of life history characteristics for blue and red king crabs in the eastern Bering Sea.

Table 6: Estimated annual bycatch of blue king crab in the Bering Sea snow crab, Bering Sea Tanner crab, Pribilof king crab, and Bering Sea hair crab fisheries, 1995-2002, as compared to annual total abundance estimates for the Pribilof blue king crab stock.

Table 7: Estimated annual bycatch mortality of blue king crab in the Bering Sea snow crab, Bering Sea Tanner crab, Pribilof king crab, and Bering Sea hair crab fisheries, 1995-2002, as compared to annual total abundance estimates for the Pribilof blue king crab stock.

Table 8: Parameters for a four-stage model used to estimate rebuilding time periods and probabilities through computer simulations for Pribilof Islands blue king crabs. All parameters are estimated from the assessment models and observer data.

Table 9: Comparisons of years required to achieve $\geq$10%, 50% and 90% rebuilding probabilities (RP), mean proportions of years with fishery closure and below MSST, and mean annual yields (million pounds) within 10, 20 and 35 years for 11 Alternative rebuilding strategies under two assumptions of recruitment dynamics.

Table1: Annual abundance estimates (millions of crabs) for blue king crab in the Pribilof District from NMFS surveys (Stevens et al. 2002).

	Males				Females			
	Small	Pre-recruit	Legal		Small	Large		
Carapace Length (mm):	<110	110-134	≥135		< 90	≥90		Grand
Width (in) :	<5.2	5.2- 6.4	≥ 6.5	Total	< 4.3	≥4.3	Total	Total
1982	1.2	0.7	2.2	4.1	0.7	8.6	9.3	13.4
1983	0.6	0.8	1.3	2.8	0.2	9.2	9.4	12.2
1984	0.5	0.3	0.6	1.3	0.3	3.1	3.4	4.7
1985	0.1	0.2	0.3	0.5	0.2	0.5	0.7	1.2
1986	<0.1	<0.1	0.4	0.5	<0.1	1.9	1.9	2.4
1987	0.6	0.1	0.7	1.4	0.4	0.6	1.0	2.4
1988	1.1	0.0	0.2	1.3	0.8	0.4	1.2	2.5
1989	3.2	0.1	0.2	3.5	2.3	1.3	3.6	7.1
1990	1.8	1.2	0.4	3.5	1.8	2.7	4.5	8.0
1991	1.3	1.0	1.0	3.4	0.6	2.8	3.4	6.7
1992	1.6	1.2	1.0	3.8	1.3	2.1	3.4	7.1
1993	1.0	0.8	1.0	2.8	0.3	2.2	2.5	5.3
1994	0.3	0.5	0.8	1.6	0.1	4.3	4.3	5.9
1995	0.8	1.2	2.0	3.9	0.4	4.0	4.5	8.4
1996	0.3	0.7	1.2	2.3	0.1	4.6	4.7	7.0
1997	0.3	0.4	0.8	1.5	0.1	2.5	2.6	4.1
1998	0.8	0.4	0.8	2.0	0.3	2.0	2.3	4.3
1999	0.1	0.2	0.5	0.8	0.0	2.5	2.5	3.2
2000	0.1	0.2	0.5	0.8	0.0	1.4	1.4	2.2
2001	<0.1	0.1	0.4	0.6	<0.1	1.6	1.6	2.2
2002	0.0	<0.1	0.2	0.2	<0.1	1.2	1.3	1.5

Table 2: Annual abundance estimates (millions of crabs) and 95% confidence intervals for 2002 of male blue king crabs in the Pribilof District estimated by 4-stage catch-survey analysis from 1975-2002. Size measurements are in mm CL. From Vining and Zheng (2003).

Year	PreRec (105-134)	Mature (≥120)	Recruit Newshell (135-148)	Post Oldshell (≥135)	Legal (≥135)
1975	6.779	11.353	3.303	3.885	7.188
1976	3.910	10.353	2.393	5.254	7.647
1977	4.548	8.169	1.633	5.127	6.760
1978	5.349	7.874	0.979	4.459	5.438
1979	2.792	7.490	1.510	3.503	5.013
1980	1.459	5.358	1.353	3.168	4.521
1981	1.111	3.300	0.495	2.201	2.696
1982	1.010	1.900	0.358	1.067	1.426
1983	0.874	1.349	0.275	0.618	0.893
1984	0.477	1.095	0.253	0.464	0.717
1985	0.192	0.882	0.203	0.516	0.719
1986	0.057	0.633	0.097	0.481	0.578
1987	0.017	0.450	0.032	0.404	0.436
1988	0.003	0.262	0.010	0.249	0.260
1989	1.331	0.196	0.002	0.194	0.196
1990	1.595	1.114	0.065	0.146	0.211
1991	1.245	1.424	0.598	0.192	0.789
1992	1.231	1.566	0.402	0.612	1.014
1993	0.991	1.688	0.340	0.776	1.115
1994	0.903	1.583	0.322	0.851	1.173
1995	0.970	1.535	0.235	0.889	1.124
1996	0.768	1.379	0.222	0.715	0.937
1997	0.415	1.154	0.219	0.615	0.834
1998	0.281	0.882	0.144	0.577	0.721
1999	0.177	0.678	0.072	0.489	0.561
2000	0.112	0.542	0.048	0.421	0.469
2001	0.069	0.427	0.029	0.352	0.381
2002	0.030	0.338	0.025	0.286	0.311
	95% Confidence Interval for 2002				
Lower	NA	0.189	NA	NA	0.165
Upper	NA	0.487	NA	NA	0.458

Table 3: Fishery guideline harvest levels (GHLs) and closure decisions for the Pribilofs blue king crab fishery, 1990-2002.

Season	GHL	Basis for GHL
1990	Closed	Extremely poor precision in stock abundance estimates; point estimate above threshold in state harvest strategy, but confidence bound reported as 213% of point estimate
1991	Closed	Poor precision in stock abundance estimates; point estimate above threshold in state harvest strategy, but lower confidence bound below threshold
1992	Closed	Poor precision in stock abundance estimates; point estimate above threshold in state harvest strategy, but lower confidence bound below threshold
1993	Closed	Poor precision in stock abundance estimates; point estimate above threshold in state harvest strategy, but lower confidence bound below threshold
1994	Closed	Extremely poor precision in stock abundance estimates; point estimate above threshold in state harvest strategy, but confidence bound reported as 146% of point estimate
1995	2.5 million pounds, red and blue king crab combined	10% exploitation rate on estimated abundance of “mature-sized” (≥120-mm CL) red king crab males only.
1996	1.8 million pounds, red and blue king crab combined	20% exploitation rate on estimated abundance of “mature-sized” (≥120-mm CL) blue king crab males only; CSA estimate of legal abundance
1997	1.5 million pounds, red and blue king crab combined	20% exploitation rate on estimated abundance of “mature-sized” (≥120-mm CL) blue king crab males only; plus 0.2 million pounds for incidental red king crab catch; CSA estimates of blue king crab mature and legal abundance;
1998	1.25 million pounds, red and blue king crab combined	10% exploitation rate on estimated abundance of “mature-sized” (≥120-mm CL) blue and red king crab males; low precision of abundance estimates, poor performance in 1997 fishery
1999	Closed	Declining stock and recruitment trend; poor precision in abundance estimates; poor past fishery performance, potential increased effort size due to St. Matthew fishery closure
2000	Closed	Stock below threshold in state harvest strategy
2001	Closed	Stock below threshold in state harvest strategy
2002	Closed	Stock below threshold in state harvest strategy

Table 4. Historic Pribilof Islands blue king crab fishery stock abundance indices and harvests, 1990-2002.

	Stock Abundance Indices					Harvest				
Year	Mature Biomass[a]	Percent of MSST[b]	Legal Males[c]	Mature Males[d]	Percent of Threshold[e]	Number Crabs Harvested	Pounds Harvested	Percent of Mature Biomass[f]	Percent of Legal Males[g]	Percent of Mature Males[h]
1990	10,560,034	160%	211,000	1,114,000	145%	0	0	0%	0%	0%
1991	13,844,888	210%	789,000	1,424,000	185%	0	0	0%	0%	0%
1992	12,588,266	191%	1,014,000	1,566,000	203%	0	0	0%	0%	0%
1993	12,742,588	193%	1,115,000	1,688,000	219%	0	0	0%	0%	0%
1994	14,903,096	226%	1,173,000	1,583,000	206%	0	0	0%	0%	0%
1995	24,934,026	378%	1,124,000	1,535,000	199%	172,987	1,267,454	5%	15%	11%
1996	18,957,355	287%	937,000	1,379,000	179%	127,676	937,032	5%	14%	9%
1997	11,552,104	175%	834,000	1,154,000	150%	68,603	512,374	4%	8%	6%
1998	10,670,264	162%	721,000	882,000	115%	68,513	516,996	5%	10%	8%
1999	9,193,182	139%	561,000	678,000	88%	0	0	0%	0%	0%
2000	7,407,456	112%	469,000	542,000	70%	0	0	0%	0%	0%
2001	7,032,674	107%	381,000	427,000	55%	0	0	0%	0%	0%
2002	4,534,862	69%	311,000	388,000	50%	0	0	0%	0%	0%

[a] Total mature male and female biomass, estimated by NMFS from annual eastern Bering Sea trawl survey data using area-swept method.
[b] Estimated total mature male and female biomass as percent of stock MSST specified in FMP, 6.6-million pounds.
[c] Abundance (number) of legal males estimated by ADF&G from annual eastern Bering Sea trawl survey data using CSA model (Vining and Zheng 2003).
[d] Abundance (number) of males ≥120-mm CL estimated by ADF&G from annual eastern Bering Sea trawl survey data using CSA model (Vining and Zheng 2003).
[e] Estimated number of males ≥120-mm CL as percent of stock threshold for fishery opening in state harvest strategy, 0.77-million males ≥120-mm CL.
[f] Pounds harvested during fishery as percent of estimated total mature male and female biomass.
[g] Number of males harvested during commercial fishery as percent of estimated abundance (number) of legal males.
[h] Number of males harvested during commercial fishery as percent of estimated abundance (number) of males ≥120-mm CL

Table 5: Comparison of life history characteristics for blue and red king crabs in the eastern Bering Sea.[a]

Characteristic	Red king crab	Blue king crab
Habitat	All bottom types, early juveniles on rock and rubble with heavy epifaunal growth, warmer waters.	Closely associates with rocky areas and islands, juveniles on shell hash, adults Sometimes offshore on smooth bottoms, cold waters.
Juveniles	Closely resemble adults in color And shape but spines are more prominent, frequently form hive-Shaped aggregations called pods	Differ from adults in color, carapace color ranges from white trough tan to blue and read, frequently mottled, spines less prominent than on adults, not known to form pods.
Growth	Adult males average 15-16 mm Growth in carapace length (CL) at each Molt	Adult males ca 14 mm in each molt
Oviposition	Normally annual	Normally Biennial
Fecundity (E) Female	E=-247,400+3,319 * CL.	E=241629-2632606 exp(- 0.028023 * CL)
Maturity	90 mm CW Bristol Bay 105 mm CW Pribilof Islands	96 mm Pribilof Islands 80 mm St Matthew Is.
Length : Males only	Weight Ln W = -14.83+3.160CL	Ln W = -8.02 +3.175CL (Pribilof) Ln W = -5.36 + 3.103CL (St. Matthew)
Landed weight	2.5 to 3.5 kg	3.5 - 3.6 kg (Pribilof) 1.8 – 2.2 kg (St Matthew)

[a] Data from various authors augmented by NMFS unpublished data.
Principal references are:
Wallace et al (1949), Haynes 1968, Balsiger 1974, Sasakawa 1973,1975a, 1975b;
Somerton and Macintosh 1985, 1983: Otto and Cummiskey 1990.

Table 6: Estimated annual bycatch of blue king crab in the Bering Sea snow crab, Bering Sea Tanner crab, Pribilof king crab, and Bering Sea hair crab fisheries, 1995-2002, as compared to annual total abundance estimates for the Pribilof blue king crab stock.

Year	Bycatch (number of animals)	Abundance[a] (millions of animals)	Bycatch as % of abundance
1995	635,150[b,c]	8.4	7.56%[c]
1996	≥63,795[d,e]	7.0	≥0.91%[e]
1997	≥67,242[f,e]	4.1	≥1.64%[e]
1998	≥54,475[g,h]	4.3	≥1.27%[h]
1999	39,648[i,j]	3.2	1.24%
2000	8,864[k,j]	2.2	0.40%
2001	0[l]	2.2	0.00%
2002	703[m]	1.5	0.05%[m]

[a] Stevens, et al. 2002.
[b] Boyle et al., 1996
[c] Estimate includes bycatch estimate for entire 1995 Pribilof king crab fishery that is based on data from only one of 127 participating vessels.
[d] Boyle, et al. 1997.
[e] Minimum estimate. Bycatch estimate for Pribilof king crab fishery not available.
[f] Moore, et al. 1998.
[g] Moore, et al. 2000a.
[h] Minimum estimate. Bycatch estimate for Pribilof king crab fishery available only from the CDQ fishery; bycatch estimate for the general ("open-access") Pribilof king crab fishery not available.
[i] Moore, et al. 2000b.
[j] Barnard, 2001.
[k] Barnard, et al. 2001.
[l] Neufeld and Barnard. 2003.
[m] Preliminary report, DR Banard, ADF&G, Kodiak, *pers.comm.*

Table 7: Estimated annual bycatch mortality of blue king crab in the Bering sea snow crab, Bering Sea Tanner crab, Pribilof king crab, and Bering Sea hair crab fisheries, 1995-2002, as compared to annual total abundance estimates for the Pribilof blue king crab stock.

Year	Bycatch mortality (number of animals)	Abundance (millions of animals)	Bycatch mortality as % of abundance
1995	50,812[a]	8.4	0.60%[a]
1996	≥ 5,104[b]	7.0	≥ 0.07%[b]
1997	≥ 5,379[b]	4.1	≥ 0.13%[b]
1998	≥ 4,358[c]	4.3	≥ 0.10%[c]
1999	3,172	3.2	0.10%
2000	709	2.2	0.03%
2001	0	2.2	0.00%
2002	56	1.5	< 0.01%

[a] Estimate includes bycatch estimate for entire 1995 Pribilof king crab fishery that is based on data from only one vessel of 127 participating vessels.

[b] Minimum estimate. Bycatch estimate for Pribilof king crab fishery not available.

[c] Minimum estimate. Bycatch estimate for Pribilof king crab fishery available only from the CDQ fishery; bycatch estimate for the general ("open-access") Pribilof king crab fishery not available.

Table 8: Parameters for a four-stage model used to estimate rebuilding time periods and probabilities through computer simulations for Pribilof Islands blue king crabs. All parameters are estimated from the assessment models and observer data.

Parameter	Males	Females
Natural Mortality (*M*)	0.28	0.30
Trawl Catchability: Pre-recruit 2 / group 1	0.76	0.89
Trawl Catchability: Pre-recruit 1 / group 2	0.83	1.00
Trawl Catchability: Legals / groups 3 and 4	1.00	1.00
Pot Selectivity: Pre-recruit 2 / group 1	0.47	0.53
Pot Selectivity: Pre-recruit 1 / group 2	0.66	0.53
Pot Selectivity: Legals / groups 3 and 4	1.00	0.53
Molting Probability: Pre-recruit 2 / group 1	0.91	0.95
Molting Probability: Pre-recruit 1 /group 2	0.73	0.73
Molting Probability: Group 3	NA	0.46
Low Recruitment Cycle Length (yr)	4-9	4-9
High Recruitment Cycle Length (yr)	4-9	4-9
St. Dev. for Cyclic Recruitment	0.51	0.51
Abundance in 2002 (millions of crabs)		
Pre-recruit 2 / group 1	0.005	0.189
Pre-recruit 1 / group 2	0.031	0.320
Recruits / group 3	0.024	0.350
Post-recruits / group 4	0.277	0.287

	Male Growth Matrix: From		
	Mean W(lbs)	Pre-recruit 2	Pre-recruit 1
Pre-recruit 2	2.44	0.11	0.00
Pre-recruit 1	3.59	0.83	0.11
Recruits	5.01	0.06	0.83
Post-recruits	6.89	0.00	0.06

	Female Growth Matrix: From			
	Mean W(lbs)	Group 1	Group 2	Group 3
Group 1	1.91	0.36	0.00	0.00
Group 2	2.27	0.64	0.49	0.00
Group 3	2.67	0.00	0.51	0.59
Group 4	3.23	0.00	0.00	0.41

Table 9: Comparisons of years required to achieve ≥10%, 50% and 90% rebuilding probabilities (RP) and mean proportions of years with fishery closure and below MSST and mean annual yields (million pounds) within 10, 20 and 35 years for 8 alternative rebuilding strategies under two assumptions of recruitment dynamics and handling mortality rate (HM). Strong candidates for the proposed rebuilding strategy are shown in bold.

Alter.	HM	Years at RP ≥			Fishery Closure			Below MSST			Mean Annual		
Yield		10%	50%	90%	10yr	20yr	35yr	10yr	20yr	35yr	10yr	20yr	35yr
Cyclic Stock–recruitment Model													
F=0	0.0	7	9	11	1	1	1	0.45	0.26	0.17	0	0	0
1A	0.2	7	10	25	0.60	0.58	0.53	0.45	0.40	0.35	0.63	0.68	0.78
1B	**0.2**	**7**	**9**	**11**	**0.75**	**0.67**	**0.63**	**0.45**	**0.31**	**0.23**	**0.28**	**0.37**	**0.45**
2A	0.2	7	10	24	0.54	0.50	0.46	0.46	0.41	0.36	0.63	0.69	0.80
2B	**0.2**	**7**	**9**	**12**	**0.68**	**0.59**	**0.54**	**0.45**	**0.32**	**0.25**	**0.34**	**0.44**	**0.52**
2C	**0.2**	**7**	**9**	**12**	**0.70**	**0.63**	**0.58**	**0.45**	**0.35**	**0.28**	**0.44**	**0.53**	**0.62**
2D	**0.2**	**7**	**9**	**12**	**0.70**	**0.62**	**0.57**	**0.45**	**0.34**	**0.27**	**0.41**	**0.50**	**0.59**
3A	0.2	7	9	20	0.75	0.73	0.70	0.45	0.35	0.29	0.52	0.58	0.68
3B	0.2	7	9	11	0.83	0.76	0.73	0.45	0.30	0.22	0.23	0.33	0.39
1A	0.0	7	9	21	0.59	0.55	0.50	0.45	0.37	0.31	0.68	0.77	0.88
1B	**0.0**	**7**	**9**	**11**	**0.75**	**0.67**	**0.62**	**0.45**	**0.30**	**0.22**	**0.29**	**0.39**	**0.47**
2A	0.0	7	9	21	0.54	0.48	0.42	0.46	0.38	0.32	0.68	0.78	0.90
2B	**0.0**	**7**	**9**	**12**	**0.67**	**0.58**	**0.52**	**0.45**	**0.31**	**0.24**	**0.36**	**0.46**	**0.55**
2C	**0.0**	**7**	**9**	**12**	**0.70**	**0.61**	**0.56**	**0.45**	**0.33**	**0.26**	**0.46**	**0.58**	**0.68**
2D	**0.0**	**7**	**9**	**12**	**0.69**	**0.60**	**0.55**	**0.45**	**0.32**	**0.25**	**0.42**	**0.54**	**0.64**
3A	0.0	7	9	13	0.73	0.70	0.66	0.45	0.34	0.27	0.56	0.65	0.76
3B	0.0	7	9	11	0.83	0.75	0.71	0.45	0.29	0.21	0.24	0.34	0.41
1A	0.5	7	12	35	0.63	0.62	0.58	0.46	0.45	0.41	0.55	0.57	0.65
1B	**0.5**	**7**	**9**	**12**	**0.76**	**0.69**	**0.64**	**0.45**	**0.32**	**0.25**	**0.27**	**0.35**	**0.42**
2A	0.5	7	11	35	0.56	0.54	0.50	0.47	0.46	0.41	0.55	0.58	0.66
2B	**0.5**	**7**	**9**	**13**	**0.68**	**0.61**	**0.56**	**0.45**	**0.34**	**0.27**	**0.33**	**0.41**	**0.48**
2C	**0.5**	**7**	**9**	**18**	**0.71**	**0.66**	**0.62**	**0.45**	**0.37**	**0.31**	**0.41**	**0.47**	**0.55**
2D	**0.5**	**7**	**9**	**14**	**0.71**	**0.64**	**0.60**	**0.45**	**0.36**	**0.30**	**0.38**	**0.45**	**0.53**
3A	0.5	7	10	23	0.77	0.76	0.74	0.45	0.38	0.32	0.47	0.49	0.58
3B	0.5	7	9	11	0.83	0.77	0.74	0.45	0.31	0.23	0.22	0.30	0.36
Random Recruitment													
F=0	0.0	4	9	20	1	1	1	0.24	0.13	0.08	0	0	0
1A	0.2	5	17	35	0.57	0.50	0.46	0.29	0.21	0.18	0.62	0.74	0.78
1B	0.2	5	10	23	0.75	0.65	0.61	0.24	0.14	0.09	0.25	0.36	0.39
2A	0.2	5	16	35	0.47	0.39	0.35	0.29	0.21	0.18	0.62	0.75	0.79
2B	0.2	5	11	26	0.64	0.53	0.48	0.24	0.14	0.10	0.34	0.45	0.49
2C	0.2	5	11	29	0.67	0.57	0.53	0.25	0.15	0.11	0.40	0.53	0.57
2D	0.2	5	11	28	0.67	0.56	0.51	0.24	0.15	0.10	0.37	0.50	0.54
3A	0.2	5	12	31	0.76	0.71	0.69	0.25	0.16	0.12	0.45	0.58	0.62
3B	0.2	5	9	21	0.84	0.77	0.74	0.24	0.13	0.09	0.19	0.29	0.31

9.0 Figures

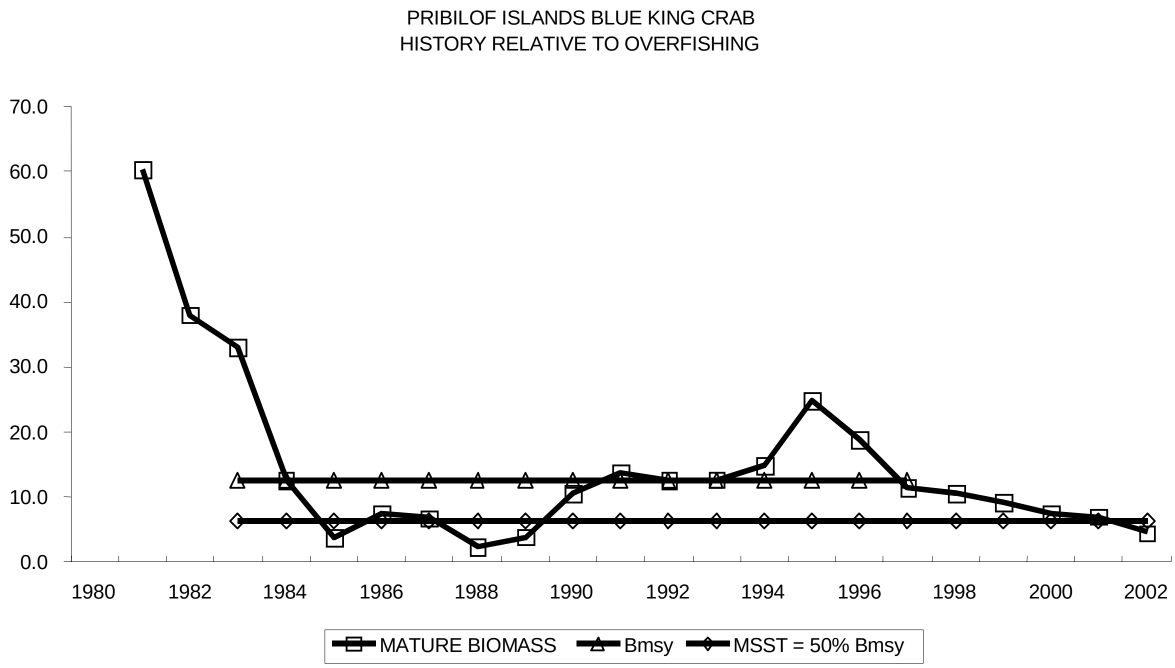


Figure 1. History of total mature biomass (MATURE BIOMASS) estimated for the Pribilof blue king crab stock relative to the MSY biomass (Bmsy) and minimum stock size threshold (MSST = 50% Bmsy) defined for the Pribilof blue king crab stock, 1981-2002. From Stevens et al. 2002

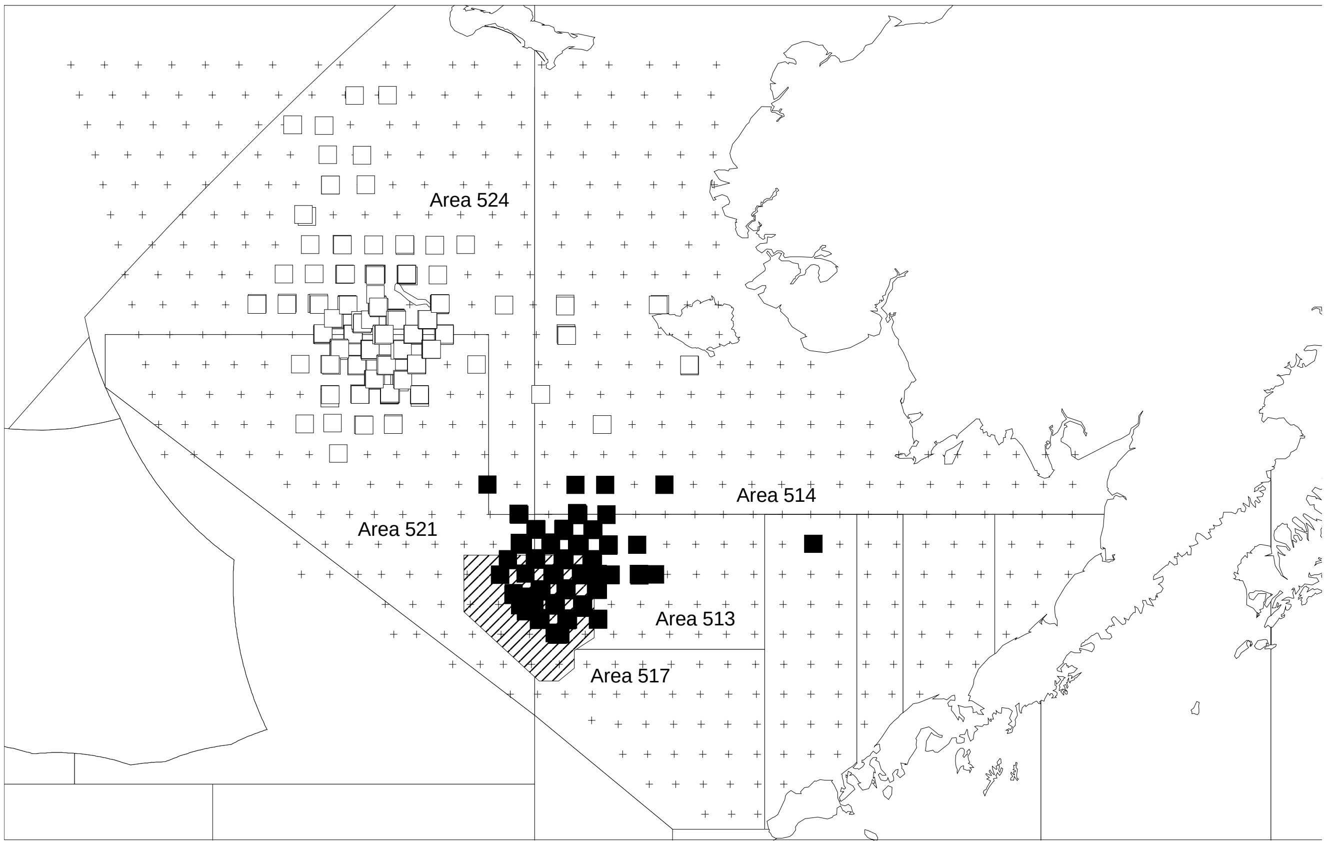


Figure 2: NMFS EBS trawl survey station centers with trawl locations that have captured blue king crab during the survey during 1995-2002. Open squares are locations of St. Matthew blue king crab captures; solid squares are Pribilof blue king crab capture sites. Crosshatched area is Pribilof Habitat Conservation Area.

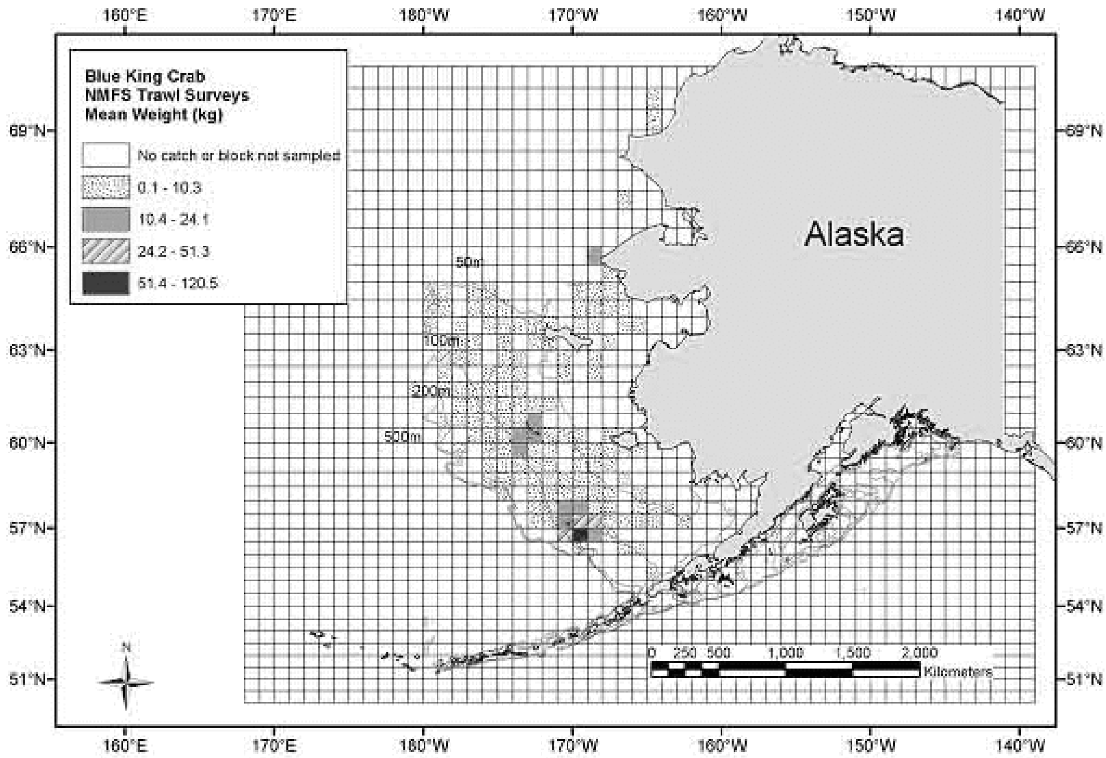


Figure 3: Mean weight per tow of blue king crab in the National Marine Fisheries Service summer eastern Bering Sea trawl survey, 1971-2002.

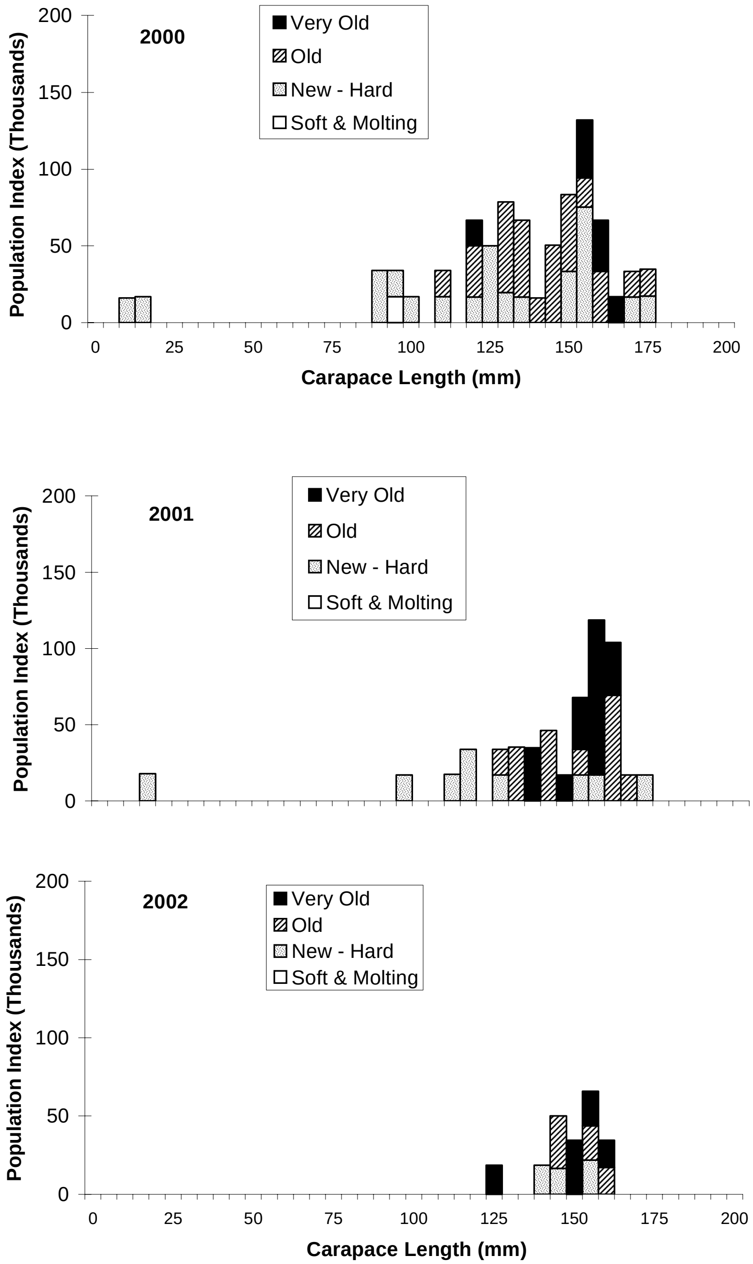


Figure 4: Size frequency distribution of male blue king crab in the Pribilof District, 2000-2002, as determined from the NMFS eastern Bering Sea trawl survey. From Stevens et al. 2002.

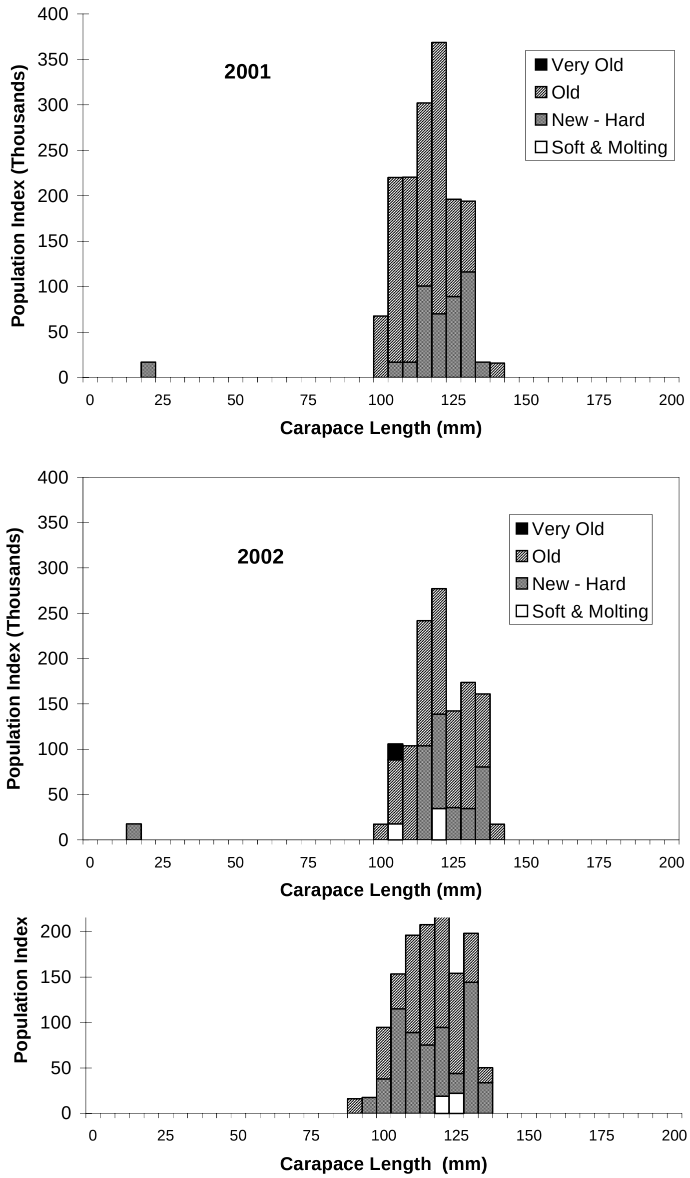


Figure 5: Size frequency distribution of female blue king crab in the Pribilof District, 2000-2002, as determined from the NMFS eastern Bering Sea trawl survey.

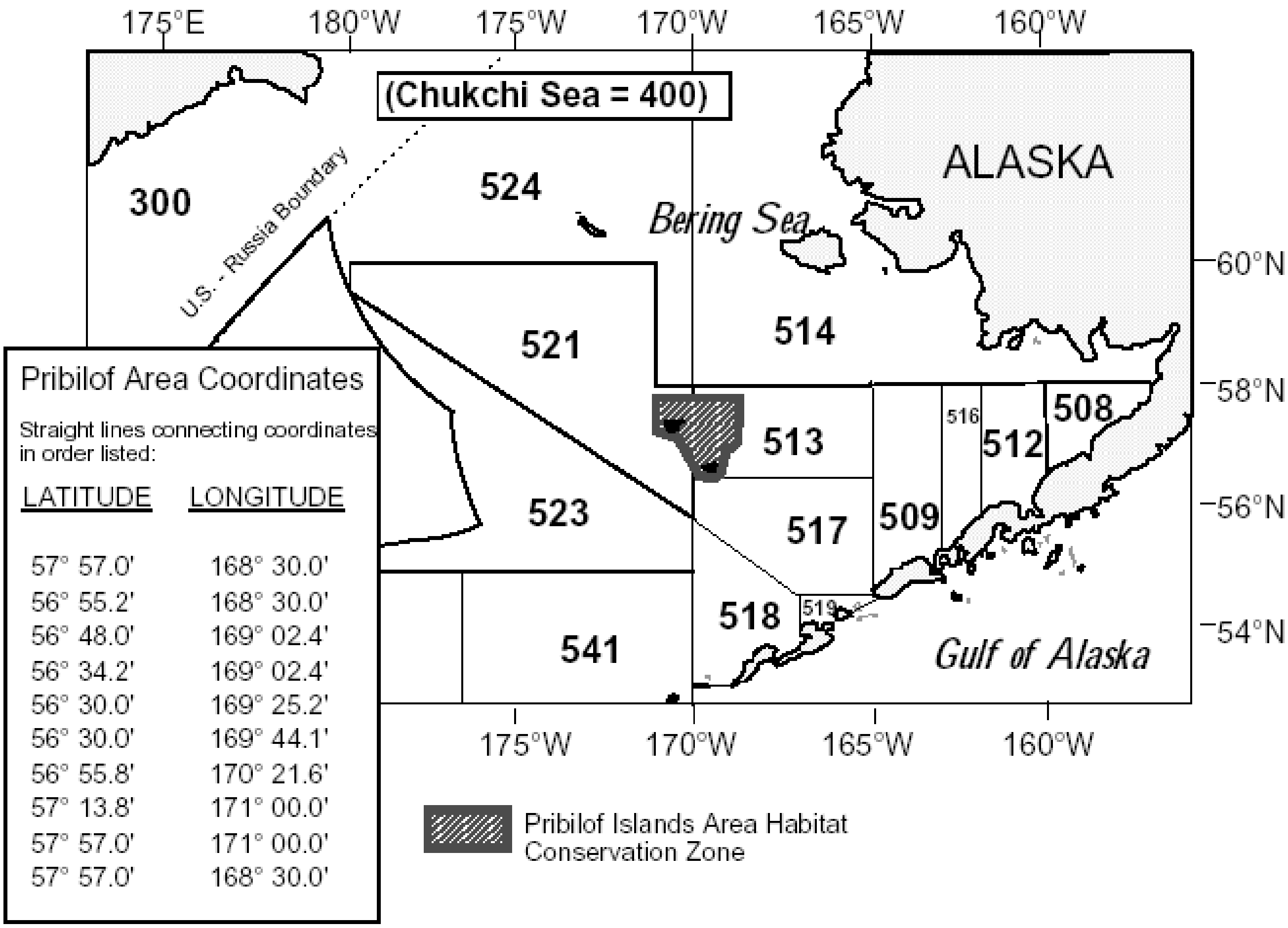
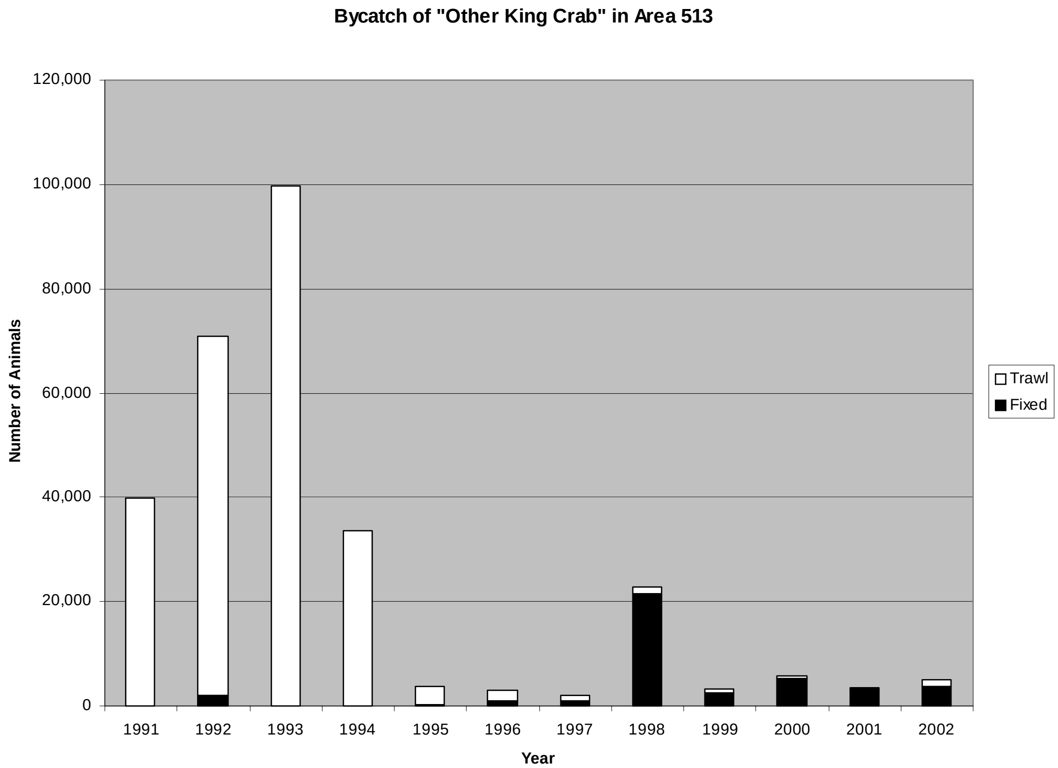


Figure 6: Pribilof Islands Area Habitat Conservation Zone.



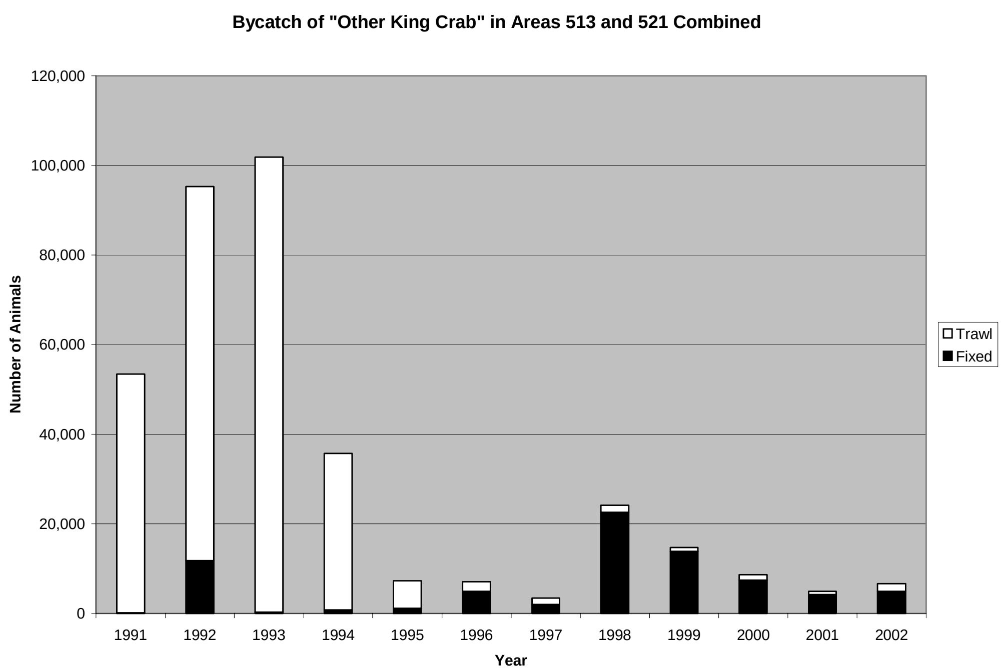


Figure 7: Bycatch of “other king crab” for trawl and fixed gear by statistical area. 7a) Upper panel, bycatch in areas 513 and 521 combined; 7b) Lower panel, bycatch in area 513

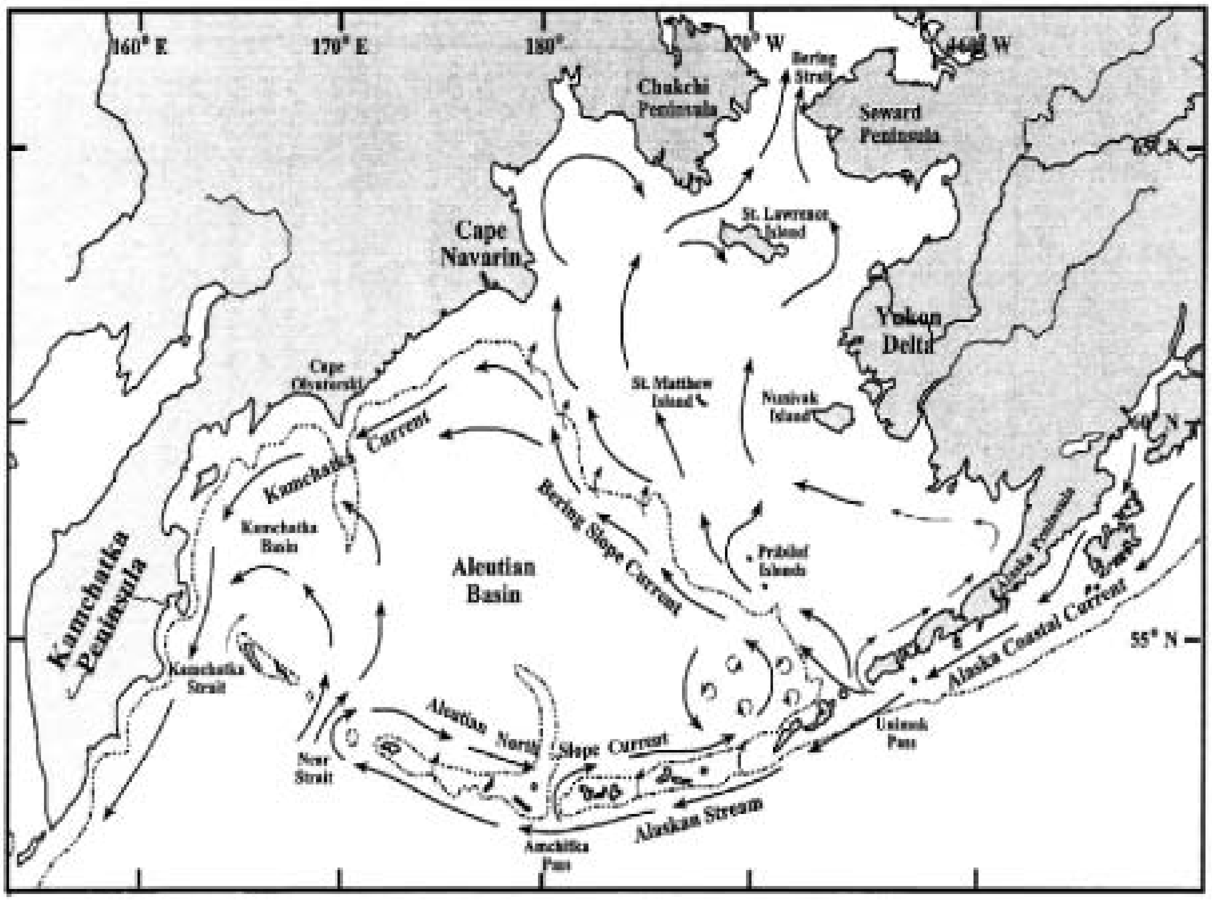


Figure 8: Major currents and direction of water flow throughout the Bering Sea (Loher, 2001)

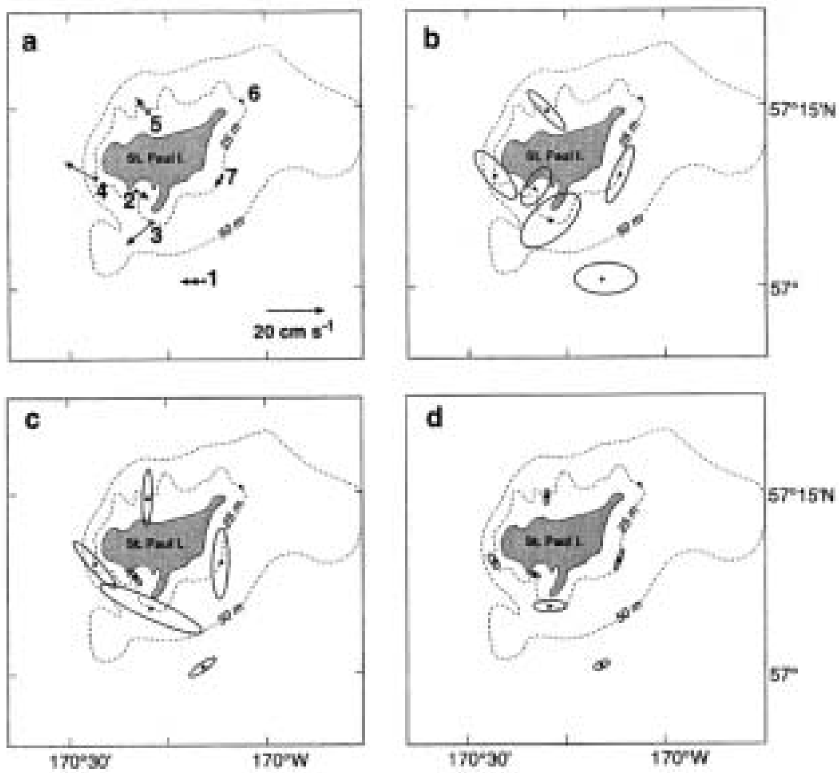
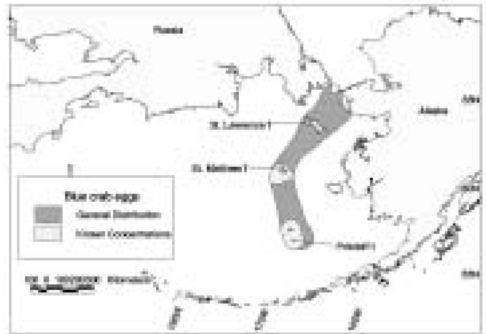
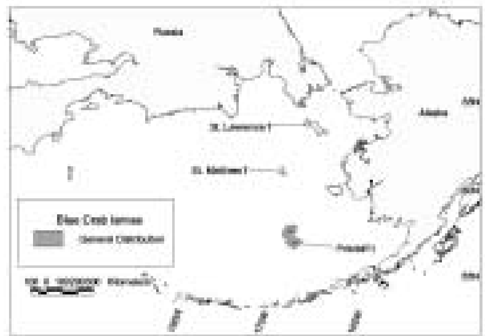


Figure 9: Results from currents meters deployed from St. Paul Island showing relative speed and tidal displacement a) mean velocity b) subtidal current ellipses oriented on the axis of greatest variance, c) tidal ellipses for the M2 tides and d)tidal ellipses for the K1 tides. (Stabeno et al. 1999)

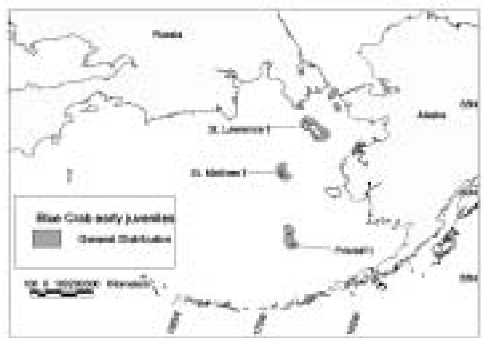
10a) Egg - Level 0b, Level 1 and Level 2
Same as Mature. Essential habitat for eggs is known for the stock of blue king crab in the Pribilof Islands based on general distribution (level 1) and density (level 2) of egg bearing female crabs. Essential habitat for eggs of the St. Matthew Island blue king crab stock is based on general distribution (level 1) of the egg bearing females. Essential habitat for eggs of the St. Lawrence Island blue king crab stock is inferred from incidental catch of mature female crab.



10b) Larvae - Level 0c and Level 1
No EFH definition determined for the St. Matthew Island and St. Lawrence stocks. Blue king crab larvae spend 3.5 to 4 months in pelagic larval stages before settling to the benthic life stage. Larvae are found in waters of depths between 40 to 60 m. Essential habitat of larval blue king crab of the Pribilof Islands stock is defined using the general distribution (level 1) of larvae in the water column. Information to define essential habitat is not available for the St. Matthew Island and St. Lawrence Island stocks of larval blue king crab.



10c) Early Juvenile - Level 0c and Level 2
No EFH definition determined for the St. Matthew and St. Lawrence Island stocks. Early juvenile blue king crabs require refuge substrate characterized by gravel and cobble overlaid with shell hash, and sponge, hydroid and barnacle assemblages. These habitat areas have been found at 40-60 m around the Pribilof Islands. Essential habitat of early juvenile blue king crabs is based on general distribution (level 1) and density (level 2) of this life stage in the Pribilof Island stock. Information to define essential habitat for early juvenile blue king crabs in the St. Matthew Island and St. Lawrence Island stocks is not available.



10d) Late Juvenile - Level 0c, Level 1 and Level 2
No EFH definition determined for the St. Lawrence Island stock. Late juvenile blue king crab require nearshore rocky habitat with shell hash. Essential habitat is based on general distribution (level 1) and density (level 2) of late juvenile blue king crab of the Pribilof Islands stock. General distribution (level 1) of the late juvenile blue king crabs is used to identify essential habitat for the St. Matthew Island stock. Information is not available to define essential habitat for the St. Lawrence Island stock of late juvenile blue king crab.

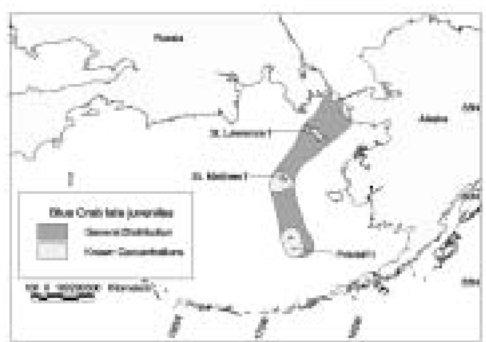


Figure 10: Current EFH definitions adopted for blue king crab life stages: 10a) Egg; 10b) Larvae; 10c) Early Juvenile; 10d) Late Juvenile

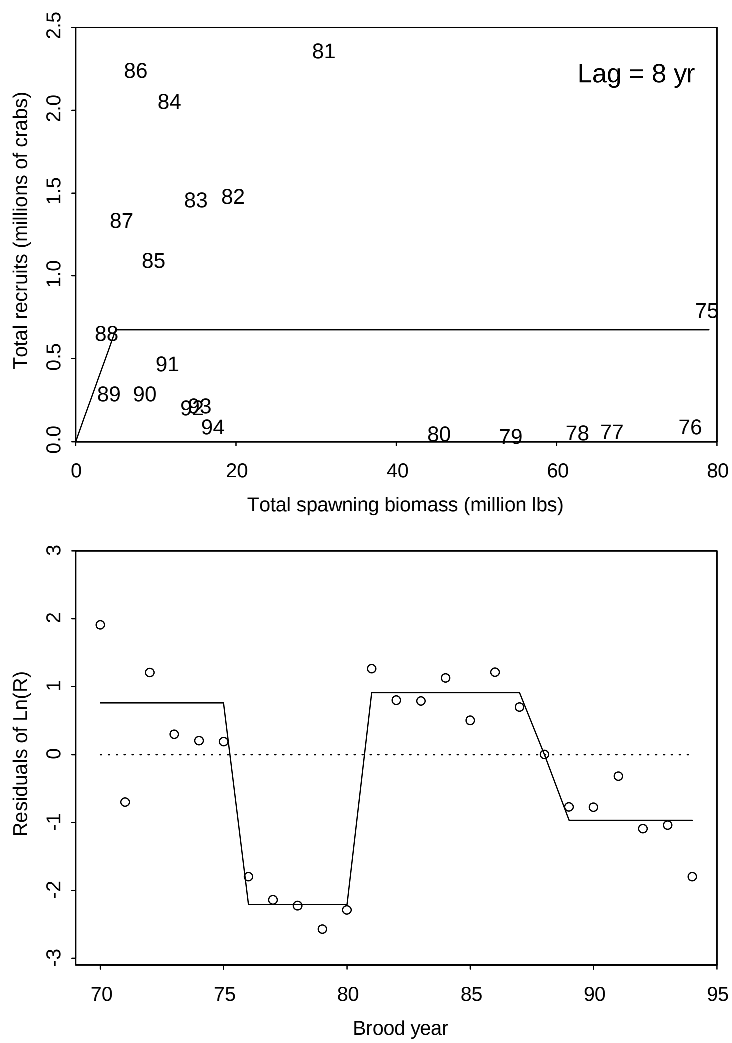


Figure 11. The relationship between total spawning biomass and total recruits at age 7 (i.e., 8-year time lag; upper plot) and residuals of logarithm of recruits from the curve (lower plot) for Pribilof Islands blue king crabs. In the upper plot, numerical labels are brood year (year of mating), and in the lower plot, the solid lines represent local means estimated from residuals

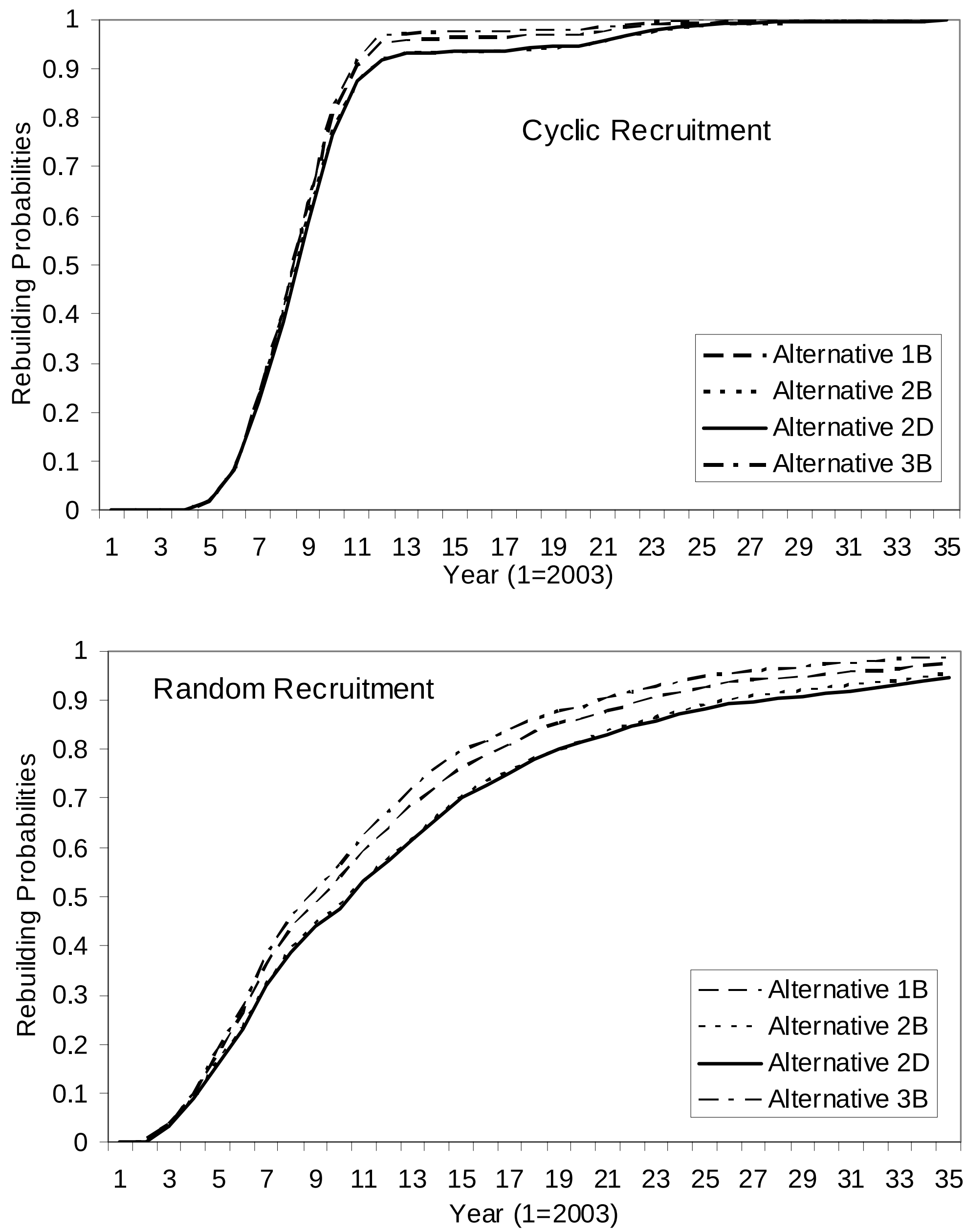


Figure 12. Estimated rebuilding probabilities for four Alternatives for Pribilof Islands blue king crabs under two recruitment assumptions.

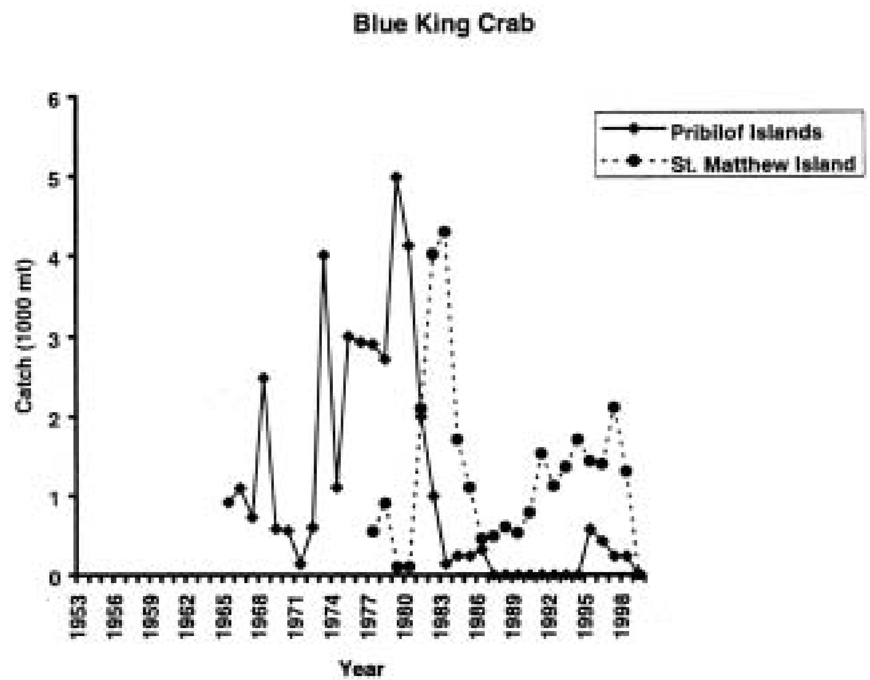


Figure 13: Historical blue king crab catch (in 100 mt) in the Pribilof Islands and St. Matthew Island. The Pribilof Islands catches are given per season (e.g., 1972 refers to the 1972/73 season) from Kruse et al. 2000